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Index to Volume IX
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Volume IX

December 1939

Number 5

METHODS OF RESEARCH IN EDUCATION

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TABLE OF CONTENTS

<i>Chapter</i>	<i>Page</i>
Foreword	451
Introduction	452
I. Library and Bibliographical Procedures	453
HERMAN G. RICHEY, <i>University of Chicago, Chicago, Illinois.</i>	
II. Current Historiography in Education	456
H. G. GOOD, <i>Ohio State University, Columbus, Ohio.</i>	
III. Legal Research in Education	460
M. M. CHAMBERS, <i>American Youth Commission, Washington, D. C.</i>	
IV. Quantitative Analysis of Documentary Materials	466
EDGAR DALE, <i>Ohio State University, Columbus, Ohio.</i>	
V. Direct Observation as a Research Method	472
ARTHUR T. JERSILD, <i>Teachers College, Columbia University, New York, New York,</i> and MARGARET MEIGS.	
VI. The Case Method	483
WILLARD C. OLSON, <i>University of Michigan, Ann Arbor, Michigan.</i>	
VII. Genetic Method	491
KAI JENSEN, <i>University of Wisconsin, Madison, Wisconsin.</i>	
VIII. The Interview	498
RUTH STRANG, <i>Teachers College, Columbia University, New York, New York.</i>	
	449

Chapter	Page
IX. Questionnaires	502
FRANK W. HUBBARD, <i>National Education Association, Washington, D. C.</i>	
X. School and Community Surveys	508
JESSE B. SEARS, <i>Stanford University, Stanford University, California.</i>	
XI. Testing: Intelligence, Aptitude, Personality, and Achievement	514
G. M. RUCH, <i>United States Office of Education, Washington, D. C.</i> , and P. T. ORATA, <i>United States Office of Education, Washington, D. C.</i>	
XII. Rating Scales, Score-Cards, and Checklists	524
LEO J. BRUECKNER, <i>University of Minnesota, Minneapolis, Minnesota.</i>	
XIII. Factor Analysis	528
KARL J. HOLZINGER, <i>University of Chicago, Chicago, Illinois</i> ; and HARRY H. HARMAN, <i>University of Chicago, Chicago, Illinois.</i>	
XIV. Index Numbers and Related Composites	532
DOUGLAS E. SCATES, <i>Duke University, Durham, N. C.</i>	
XV. Statistical Methods	543
PALMER O. JOHNSON, <i>University of Minnesota, Minneapolis, Minnesota.</i>	
XVI. Classroom Experimentation	555
MAX D. ENGELHART, <i>Chicago City Junior Colleges, Chicago, Illinois.</i>	
XVII. Laboratory Investigations	564
L. C. GILBERT, <i>University of California, Berkeley, California.</i>	
XVIII. Organized Research in Education: Foundations, Commissions, and Committees	569
CARTER V. GOOD, <i>University of Cincinnati, Cincinnati, Ohio.</i>	
XIX. Organized Research in Education: National, State, City, and University Bureaus of Research	576
DOUGLAS E. SCATES, <i>Duke University, Durham, North Carolina.</i>	
Bibliography	591
List of Members	647
Index	663
Index to Volume IX	666

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FOREWORD

THIS ISSUE of the *Review* might be labelled "Research takes time out to examine itself." It is a sort of methodological résumé of the studies which have been reported in various fields in the preceding issues of the *Review*. It includes five types of material: (a) new developments in research technics; (b) evaluative studies of research technics; (c) new types of applications of given technics; (d) illustrations of current uses of technics; and (e) notes on needed research, especially that which is contingent upon the development of new approaches.

The order of presentation of the methods and technics is: documentary, observational and clinical, survey, statistical, and experimental. The two final chapters deal with the administrative side of research. The chapter topics are not presumed to be coordinate; some deal with broad methods of work, some with narrower technics; but all have their place in a consideration of research processes.

There have been a number of previous treatments in the *Review* dealing with research procedures, in contrast to research findings. These have appeared as follows: April 1932, Chapter V; October 1932, Chapter IV; December 1932, Chapter I; February 1933, Chapters II and III; February 1934, Chapters I to XIII; April 1934, Chapter III; June 1934, Chapter II; April 1935, Chapter IV; June 1935, Chapter IV; October 1935, Chapter I; December 1935, Chapter III; February 1936, p. 54-60; December 1936, Chapter VII; February 1937, Chapter II; June 1937, Chapter II; June 1938, Chapter VIII; October 1938, Chapters VII and XIII; February 1939, Chapter V; April 1939, Chapter IV.

The issue of February 1934 was given wholly to research attacks but was organized by fields of application so that the processes did not emerge so clearly and generally as under the present form of treatment. With the exception of these former treatments the present issue has no predecessors, and much of the content therefore has no definite earlier time limit. This fact has operated to make the issue longer than usual in spite of a consistent attempt to make each treatment as compact as possible. A number of chapters could profitably have been doubled in length.

Turning our attention to methods of work and consciously examining them should increase the efficacy of research in dealing with problems.

DOUGLAS E. SCATES
Chairman of the Editorial Board

INTRODUCTION

THE FEBRUARY 1934 *Review* on "Methods and Technics of Educational Research" was organized primarily in terms of the fields to which investigational methods are applied, with chapters devoted to methods of research in such areas as the curriculum, teacher personnel, school organization, teaching method, finance, buildings, tests, child psychology, pupil personnel and guidance, and school law. Such a treatment of research procedures is useful to the worker especially interested in a given subdivision of education, although it involves duplication by reason of discussing a particular method in a number of different chapters and of course does not present systematically in one section the various technics and applications of an investigational procedure. The limitations inherent in the organization of this earlier number of the *Review* caused the committee in charge of the present issue to outline the chapters in terms of the methodology of educational research. Such an organization in keeping with problem-solving approaches or research procedures seems a functional one, with both logical and psychological values, as illustrated by including in one chapter the technics of the school and community survey as a problem-solving mode of attack, together with appropriate examples of application to a number of fields.

The authors of the several chapters were requested to stress recent developments in technics and new applications of each research method, with the present number of the *Review* representing a supplement to, rather than a duplication of, material already available in published books on methodology. In contrast with this issue of the *Review*, Part II of the 1938 yearbook of the National Society for the Study of Education, *The Scientific Movement in Education*, deals primarily with the contribution of research to the numerous subdivisions of education; and the section devoted to methods of inquiry is not intended to serve as a detailed survey of the literature. The 1939 joint yearbook of the American Educational Research Association and the Department of Classroom Teachers, *The Implications of Research for the Classroom Teacher*, summarizes concisely the findings of research in the various fields of education, especially the school subjects, with only a few supporting references for each chapter.

The publications characterized in this introductory statement, together with the present issue of the *Review*, present impressive evidence of a greatly expanded and improved literature of educational inquiry. In this development, methods from a variety of fields—philosophy and logic, mathematics and statistics, sociology and social work, psychology and experimental science, history, economics, law, and library science—have made their contributions.

CARTER V. GOOD, *Chairman*
Committee on Methods of Research in Education

CHAPTER I

Library and Bibliographical Procedures¹

HERMAN G. RICHEY

THIS CHAPTER deals with the literature concerning the effective use of library resources in solving educational problems. It is not primarily concerned with general reference books, prepared bibliographies, or indexes of the literature, but with articles and longer treatments indicating how these and other aids may be employed to locate all materials that bear upon the different fields of education or upon the various aspects of those fields. In other words, this chapter does not deal with reference books and guides; rather it attempts to list and briefly evaluate the more recent efforts to make known the contributions that bibliographical and library aids can make to the solution of educational problems.

Library Consultant Service

Between 1932 and 1937, the Library Consultant Service (11) of Teachers College, Columbia University, published fourteen issues of the *Library Consultant* (30), a mimeographed bulletin designed to aid students in bibliographical and research activities. In 1937 the *Library Consultant* was superseded by two publications (30)—the *Library Consultant Service Leaflet* and the *Library Consultant Book List*. The first of these was designed to give directions for using library and bibliographical tools; the second, to present lists of references in closely defined subjects.

Guides somewhat similar in nature to those published as issues of the *Library Consultant* have been published in different volumes of the *Teachers College Record*. Among these, Witmer's "Educational Research; A Bibliography on Sources Useful in Determining Research Completed or under Way" (45), Witmer and Miller's "Guides to Educational Literature in Periodicals" (46), and Witmer and Miller's "U. S. Office of Education Serial Publications" (47) are useful. Witmer and Feagley's "A Beginner's Guide to Bibliography" (44), published separately, is a similar aid.

Carter Alexander, appointed a member of the Consultant Service in 1932 to act as guide and mediator in giving bibliographical assistance to students of school administration, a few months later became the pioneer library professor attached to the library of an institution for training in educational research (5). As library professor the scope of his work was enlarged to include giving bibliographical aid to all students engaged in

¹Bibliography for this chapter begins on page 591.

research, giving instruction in library resources and methods, and preparing teaching materials in library procedures.

Basic Teaching Materials

In 1935 Alexander (4) published a text and reference book, which was the outgrowth of his work as library consultant and professor. This volume made available for all students in the field of education the specialized knowledge of the reference librarian that related to education and indicated how such knowledge could be made to serve investigators of educational problems. The text was accompanied by a book of exercises (2) designed to develop skill in locating and using the library resources described in the text. The textbook may be supplemented by *Educational Research* (3) by the same author; the articles by Witmer and her associates (44, 45, 46, 47); the various issues of the *Library Consultant* (30); Monroe, Hamilton, and Smith's *Locating Educational Information in Published Sources* (34); Abel's "Guides for Studying Comparative Education" (1); Edwards' "Where and How To Find the Law Relating to Public School Administration" (19); Townsend and Stewart's *Guides to Study Materials for Teachers* (41); Foster and others' "Aids in Selecting Enrichment Materials" (20); and by several guides developed by students under the direction of Alexander.

Students working under Alexander have compiled excellent guides to library materials on the following subjects: the curriculum (18), elementary education (32), health and physical education (12, 16, 39), locating the school law (14), periodical literature on natural science (29), Negro education (15), penal education (36), rural education (13), secondary education (33), speech education (40), education of teachers (28), vocational research and criteria for measuring vocational success (17, 35), public school administration (10), the handicapped child (31), and industrial arts education (23).

Library Procedures in General Treatments of Research Methodology

Several textbooks dealing with research methods and technics included useful sections on the library. Good, Barr, and Scates (22) discussed sources of information and types of educational literature, guides to educational literature, periodical literature in education, systematic organization of educational literature, and other topics. Headley's chapter "How To Use the Library" (24) and the fifth revision of the manual by Hutchins, Johnson, and Williams (26) provided basic instruction in general library procedures for students less advanced than those for whom Good and his associates wrote. The text by Good, Barr, and Scates should also be supplemented by the writings of Reeder (37), Whitney (42), Almack (6), Good (21), and others.

Library Procedures in Special Aids

Valuable aids were contained in highly specialized treatments of library resources and methods, such as government publications and library handbooks.

Government publications—Schmeckebier's *Government Publications and Their Use* (38) and Boyd's *United States Government Publications as Sources of Information for Libraries* (9) provided not only a list and description of materials, and a bibliography of guides available for use in connection with them, but also discussions of the use, classification, and availability of the materials and guides. These volumes were supplemented by some of the volumes of the annual publication, *Public Documents* (8), Weyer's *U. S. Government Documents* (48), and similar works. Higgins' *Canadian Government Publications* (25) is indispensable to the research worker making use of published information from the Canadian government.

Handbooks—Handbooks have been prepared for use in connection with some libraries (27, 43). These are specially helpful in the libraries for which they were written and some have been made, with minor modifications, to serve more generally (26, 27).

Future Developments

Within the next few years there promises to be an extensive development of literature on library methods and on procedures centering about the use of the camera which was until recently employed by scholars only in notetaking and manuscript collation. However, with the improvement of the projector and its adaptation to microphotography, library use of the camera has been extended to "(1) making library holdings available outside, in extension of interlibrary loans; (2) commanding the basic materials for research, especially the bulky records of the social sciences and the humanities; (3) preservation of the perishable, such as newspapers; and (4) making available the results of research, such as *Science Service* offers in partnership with science editors to preserve and film in full on demand any paper they print in abstract" (7: 1936, p. 120).

At present the literature on microphotography is, for the most part, concerned with the problems of librarians; but the work being done in numerous centers brings nearer the time when scholars will need indexes, union lists, and other guides to the use of microfilms and some instruction in the methods and procedures involved in their use.

CHAPTER II

Current Historiography in Education¹

H. G. GOOD

THIS CHAPTER is concerned with problems and trends in the writing of educational history rather than with the content of such history. Recent contributions to the history of education were dealt with at length in the October 1939 issue of the *Review of Educational Research*. It is not therefore the province of this chapter to attempt any review of recent historical writings with a view to giving a résumé of their findings. It is, instead, our purpose to attempt to observe certain developments in the methods and interests of educational historians, and historical contributions will be cited only as illustrations of these observations.

Treatises on Historical Method

In the past few years a number of treatises on historiography have appeared. While the principles of historical research have remained practically the same for some time, elaborations of these principles and various specific applications of them are presenting new aspects. Several books on educational research methods (50, 68, 94) have contained chapters relating the historical technics particularly to educational materials and problems. Detailed bibliographies will be found in these chapters, citing a wealth of supporting material. No book dealing solely with the problem of research in educational history is known, but the principles of general historical research and history writing are presented in a number of recent texts which the research worker should consult. The most helpful of these are: 51, 53, 57, 61, 73, 76, 79, 83, 87, 91. Space is available for only a composite summary statement of the content presented and the principles developed in these recent books on historiography. We may conveniently take this from a recent review by Good (67):

Documents and remains are the chief primary sources, the first witnesses to a fact and therefore the only solid bases for historical research, although classifications of sources have been broadened within recent years. In the case of secondary sources, more than one mind has come between the historical event and the user of the sources.

The sources are subjected to external and internal criticism. External criticism is concerned with the genuineness of the document as such, and deals with data relating to form and appearance rather than meaning of contents. Internal criticism deals with the meaning and trustworthiness of statements within the document—that is, it weighs the testimony of the document in relation to the truth. External criticism makes use of certain auxiliary sciences and a variety of procedures in dealing with forgeries and hoaxes, inventions and distortions, authorship and time, and borrowings. Internal criticism seeks to determine the literal meaning and the real meaning of statements, the competence of the observer, the truthfulness and honesty of the observer or author.

¹ Bibliography for this chapter begins on page 503.

Historical composition is a synthetic and constructive process which involves the mechanical problem of documentation, the logical problem of selection and arrangement of topics and subtopics, and the philosophical problem of interpretation. An appropriate combination of the chronological and topical plans for arrangement of topics and materials is recommended. Few works in history have been directly touched by one of the broad philosophies or theories of history, such as the evolutionary hypothesis or the rhythm-philosophy (cycle theory). Specific schools of historical interpretation, such as economic determinism, permit a pragmatic test, through use of historical materials, and are of more general interest to writers and users of history, although many of the best historical works have been written according to the individual bent of the author rather than in keeping with some special interpretation or school of thought. The development of a newer type of history, which is eclectic in approach and interpretation, necessarily depends on the contributions of many sciences for gathering and interpreting evidence and for training its workers.

Only when a perplexing question has been identified and correctly stated does profitable study of history begin. Inductive reasoning is, of course, the procedure open to the historian, in making penetrating inductive inferences from known facts which offer only a partial explanation. In turn, the superimposing of the general explanatory concept upon the facts or the testing of the working hypothesis represents a deductive process. As a rule, multiple causation is the explanation of any important historical event. The problem of historical perspective represents great difficulties because of tendencies to evaluate events and personages, distant in time or space, according to the standards of our own time and culture. Few histories of distinction lack a thesis or principle of synthesis, such as the effect of the frontier on American life and character. The literary aspects of historical writing include consideration of mastery of materials, the working outline, the principle of progression, emphasis on major elements, and the art of narration and dramatization.

New Basic Materials for the Historian

Rapid technological development is taking place in methods of reproducing all kinds of documents, as lithoprinting, photo-offset, microcopying, sound recording, and others. Binkley (54) reported on these for the Social Science Research Council. The Union Catalog of the Library of Congress enables one to locate rare books in five hundred American libraries. This is an author catalog. Large libraries contain similar finding lists for other types of material, such as the *Union List of Serials* (70), the *American Newspaper Files* (69), the *Writings on American History* (72), and the several publications on manuscript collections. One of the most valuable new tools is the *Dictionary of American Biography* (77) in twenty volumes, completed two years ago at a cost of \$650,000, and containing the biographies of 13,633 distinguished Americans. One in every ten of these, that is about 1,300, filled important educational positions as teachers, presidents, or professors in colleges and schools, scientists, and other research workers. There is not space to speak of the individual biographical works of recent years or of the excellent histories of higher institutions, but Morison's work (81, 82) on the history of Harvard, and MacCracken's guide (80) to American colleges and universities must be named.

A recent development which is of major importance to the history of education as a scholarly pursuit and to all scholarly work in the United

States is the establishment of numerous university presses and the publication activities of the educational foundations and of the Council of Learned Societies. The reader may find it interesting to check this remark against the bibliography for this chapter.

Significant Historiography

The history of education deals with problems old and new. Perhaps no problem can be disposed of finally and forever. Not only are previously unknown or unused documents becoming available, but new interpretations also become necessary as the climate of opinion changes. A school which a century ago taught the three R's and religion—otherwise the four R's—and taught them well according to the demands of that day (by mechanical and drill methods) was considered a good school. Not so now; we do not judge schools as they were judged in 1840. The same applies not only to the schools themselves but also to the relations between the schools and society. We now believe schools must do their share in preparing the young for a better society if ever there is to be a better society. They must do their work effectively but also tactfully within the framework of the present society. This is really the problem of problems for American education and American life today.

The problem is a basic one in democracy. How can the schools at the same time be conservative and progressive, responsive to the people's will, and yet leading on to better things? Historical studies which deal realistically with education must include these relations of the school to society, and especially to the social pressure groups and special interests. The growing concentration of economic power without appropriate social responsibility is an illustration of the problem of special interests versus the interests of the whole people.

Some of the recent social histories of education have been quite as realistic as the histories of administration and legal aspects. Some years ago Carlton (55, 56) studied the effect of economic influences upon education itself and the educational program of the Workingman's Party. Curoe (59) made a much more extensive study of the educational policy of organized labor. Several of the volumes issued by the Commission on the Social Studies belong to the present category. Curti (60) wrote the history of the social ideas of ten American educators, Pierce (84) the history of propaganda in schools, and Beale (52) the history of prejudice and pressure in education.

A telling biography by Garber (65) is on the life of J. C. Kilgo, sometime the fighting president of Trinity College (now Duke University), North Carolina, who against a rabid press and public defended one of his professors who had ventured to write in praise of Booker T. Washington. Gellerman's study (66) of the American Legion, an economically conservative propaganda and pressure group, showed that the Legion is not

representative of the ex-service men of whom only one-fourth or less belong. Tryon (90) wrote for the Commission on the Social Studies a history of history-teaching. Culver (58) prepared an extended study of the attacks upon Horace Mann by sectarians, some of them inspired by book companies. Stauffer (88) wrote on the influence of the Bavarian Illuminati and Koch (78) on the Cult of Reason with the decline of Puritanism in the later eighteenth century. Willey (95) reported on the current depression and its influence in the field of American higher education. Hollis (74) offered a history and an analysis of one hundred larger and smaller educational foundations. Each of the two largest has control of a capital of \$150,000,000, and there are many which direct smaller but still very large sums.

Emphasis on School Organization, Administration, and Law

Carrying out the tendency toward realism in educational history, many recent studies have dealt with the organization and administration of schools and with school law. We may cite some illustrative studies. Reller (86) dealt with the origins and development of the city superintendency. Pierce (85) made a study of the history of the principalship in twelve cities.

Williams (96) traced the development of the state board of education in California, noting the trend toward centralization. Almack (49) discussed the development of school administration in general. Griffey (71) studied the history of local school control in New York State, and Holt (75) the twentieth-century progress in establishing a more effective system of schools in Tennessee.

One of the early students of the history of school law was Elsie Clews who dealt with the Colonial period. Recently such studies have multiplied. Elliott and Chambers (63) presented a selection of charters, constitutional provisions, and court decisions relating to fifty-one representative institutions. The same authors in another volume (64) gave analyses of court decisions and treated their bearings upon college and university problems. Works by Edwards (62), Voorhees (92), Trusler (89), and Weltzin (93), while primarily reference or textbooks, represent research in the field of school law and indicate a growing trend in documentary study.

CHAPTER III

Legal Research in Education¹

M. M. CHAMBERS

THE RESULTS OF RESEARCH in the legal aspects of education have been summarized in previous issues of the *Review*. In contrast to such summaries the present chapter is concerned with the methods and materials of legal study and refers to the summaries of studies only as examples of available materials.

Research methods used in the field of educational law were discussed in the *Review* for February 1934 by Edwards (111). Treatments of the same subject have been published elsewhere by Alexander (97), Chambers (100), Coffey (106), Cyr and Cunin (108), Edwards (112), and Good, Barr, and Scates (114). All these have presented useful outlines of the classifications of law, the sources of school law, and the indexes and other bibliographic aids available in law libraries. It would be out of place here to reproduce any such comprehensive guides. Instead, a fivefold task is undertaken: (a) to summarize some new approaches and uses of legal research in education; (b) to note some recent changes and additions among the legal bibliographic aids; (c) to offer certain suggestions regarding the analysis and digesting of legal materials; (d) to discuss needed research and the organization of facilities and personnel therefor; and (e) to present a synthesis of the place of legal research in education.

New Applications of Legal Research in Education

The broad study of federal relations to education conducted by the Advisory Committee on Education under the chairmanship of Floyd W. Reeves involved some legal research in almost all its phases. In addition to its attention to legal backgrounds, the Committee caused to be made a special study of selected legal problems in providing federal aid for education. In this undertaking Hamilton and Mort (117) found "no insurmountable obstacle to ultimate nationwide equalization" of school support; that "the federal aid statute should be drawn with sufficient particularity to authorize the use of federal funds for purposes which Congress deems educationally desirable but which may not, under present state law, be accomplished in some states through the use of state funds"; and that "to assure the availability of federal funds for transportation purposes the federal act should either (a) expressly provide for such use, or (b) require that the states bring their transportation statutes into accord with the purposes of the federal grant."

The legal vocabulary of school administrators was studied by Kephart (118) through the construction and use of a vocabulary test based on the commoner sources of school law. He concluded that the average school-

¹ Bibliography for this chapter begins on page 594.

man's mastery of technical legal words and phrases is only about 60 percent of what it should be, and recommended that the deficiency be remedied in courses for administrators.

Summaries of Legal Studies

At least thirty-four doctoral dissertations in the field of school law have been completed in American universities during the years 1936, 1937, and 1938. Abstracts of all these have been collected and published by Good (115, 116), who also listed 119 dissertations completed during the period 1918-35 (113). The dissertations of the three years just past may be classified crudely by topic as follows:

State histories of legislation or court decisions.....	7
School finance, property, or business management.....	13
Teaching personnel	7
Curriculum control	2
Public support for private or parochial schools.....	2
Religion in public schools	1
Relationships between cities and school districts.....	1
Intercollegiate athletics	1
Total	34

Two areas in which there have been important developments but which do not appear among the topics studied are the administration and interpretation of teachers' tenure statutes and state regulation of the selection and provision of textbooks. Inspection of Good's abstracts (115, 116) will disclose other gaps in the dissertations, constituting wide-open opportunities for new studies.

Twenty-eight masters' theses completed in 1935 and 1936, and eighteen completed in 1937, were also listed by Good (115, 116). For summaries of earlier research in educational law resort may be had to an issue of this *Review* devoted wholly to the subject (110), and to chapters in more recent issues dealing respectively with teacher personnel (102) and the school plant (99). The series of *Yearbooks of School Law* (105) edited by Chambers with the collaboration of a number of specialists carry topical summaries of changes in educational laws and have appeared annually beginning with 1933.

Changes and Additions among Bibliographic Aids

Among the legal encyclopedias it is to be noted that *Corpus Juris* was completed in 1935 with its seventy-first volume, and its publishers immediately instituted a new work which will eventually supersede it except for historical purposes, entitled *Corpus Juris Secundum* (107). This work has not as yet proceeded far enough in the alphabetical list of topics to reach "Schools and School Districts," and hence Volume 56 of *Corpus Juris* and the annual supplementary volumes are still in current use; but a com-

prehensive new article on "Colleges and Universities" has already appeared in Volume 14 of *Corpus Juris Secundum*, bearing a date of 1939.

Likewise, the well-known *Ruling Case Law*, completed in 1930 with the publication of the eighth volume of its *Permanent Supplement*, has for its successor a new work entitled *American Jurisprudence* (98), of which twenty-one volumes have been published since 1936. Neither "Schools" nor "Universities and Colleges" has as yet been reached in this series, but both will in due course be covered in new articles.

The fact should not be overlooked that there are for some states encyclopedias of the law of that jurisdiction only, such as *California Jurisprudence*, *Texas Jurisprudence*, and *Ohio Jurisprudence*. In such works the article devoted to "Schools" is a veritable textbook of the school law of the state, as well as a research tool carrying citations which will lead the student promptly to the important decisions in that jurisdiction.

In the *American Digest System*, the end of the decade 1926-36 brought the appearance of the new *Fourth Decennial Digest*, consisting of thirty-four volumes, "Schools and School Districts" being in Volume 27. Furthermore, the name of the monthly *Current Digest* was changed in 1936 to *General Digest*, and the monthly issues are now being cumulated at intervals of five months instead of semiannually as in recent years.

Various *State Digests* continue to be published from time to time, and despite the excellence and comprehensiveness of the *American Digest System* these compilations are invaluable keys, due to the fact that they cover decisions of the general trial courts as well as those of the appellate courts. It is not practicable here to list them by title and publisher, but the thorough student of school law is advised to ascertain what state digests are available for any particular state he may be studying in detail.

Having mastered the technics of finding judicial decisions, the research worker should read the same case, when possible, in both the appropriate unit of the *National Reporter System* and in the *State Reports*, due to the fact that the latter often carry headnotes written by the court, and frequently print arguments of counsel which sometimes throw much light on the case and also cite additional sources.

How To Read and Abstract a Judicial Opinion

Much of Anglo-Saxon law is judge-made, because statutes must be frequently construed by the courts in litigated cases, and because the courts are called upon to decide many controversies not covered by statutes at all. Thus the ability to analyze and digest, compare and contrast, interpret, and correctly abstract the recorded opinions of the courts is of prime importance in school law research. Ten suggestions concerning how to study and use a decision, once it is found, are offered at this point (100: 17):

1. Observe what court is being reported and, if the case is on appeal, from what court or courts it has been appealed.
2. Observe the form in which the action is brought—whether it is a petition for a writ of *mandamus*, injunction, *quo warranto*, or prohibition; or a suit for pecuniary

damages in tort or in contract; or an action in equity for the specific performance or reformation of a contract or for an accounting of partnership or corporation affairs; or a criminal action brought in the name of the state against a defendant accused of violation of a penal statute.

3. Segregate and digest the statement of the *facts* of the case, before trying to understand the application of the law to the facts.

4. Determine what is the precise question of law which the court is called upon to decide. The court's answer to this precise point is the *decision* of the case.

5. Note whether the decision seems to be in harmony with any broadly accepted rule of law. (Often the court will state the broad rule.)

6. Note whether the court indulges in any discussion of points on which it is not called upon to decide. Judicial pronouncements not directly related to the *ratio decidendi*, or determination of the legal issue in the case, are called *dicta*, and rank much lower than the *decision* in point of weight as precedents. Nevertheless, a mere *dictum* often is a figurative bomb packed full of brilliant philosophy which will illuminate its area of the law for years to come.

7. In view of the fact that all courts of last resort and most appellate courts are collegial—that is, consisting of several judges sitting *en banc*—note whether the decision and the opinion are concurred in by all the judges sitting or whether one or more judges have filed specially concurring opinions or dissenting opinions. These may be important for the sake of the social philosophy they express. A large proportion of the essential wisdom to be extracted from the records of the United States Supreme Court for a generation past is to be found in the long line of brilliant dissenting opinions by the late Justice Oliver Wendell Holmes. These opinions were frequently concurred in by Justice Brandeis, later by Justices Stone, Roberts, and Chief Justice Hughes, finally coming to represent the social philosophy of a majority of the court in many particulars.

8. Try to orient the case in your own social and legal philosophy; evaluate the decision and the opinion critically, sympathetically, tolerantly; struggle to interpret it and express it vividly and meaningfully; make it live in the mind of your reader.

9. Get the complete and correct caption and citation, including date.

10. Jot down the supporting authorities cited in the course of the opinion and follow them up, thus developing the history of the principles of law involved and disclosing trends.

Needed Research, Facilities, and Personnel

One hundred and ten current problems in educational law were listed by Chambers and associates (104). The list was drawn up from a nationwide viewpoint and could be greatly extended if made to include specific problems peculiar to particular states and regions. Some inkling of the fact that the solution of these problems has significant bearings upon the future of American democratic society may be had merely from a moment's reflection upon the first question in the list: "Shall any state permit any feature of its laws relating to residence tuition, or transportation of pupils to remain such that any boy or girl of secondary-school age is denied reasonably easy access to suitable high-school facilities?"

Another brief published discussion of issues in school law (101) treated four great areas in each of which are many unsolved problems: (a) teacher tenure legislation and its interpretation, (b) relations between the public and private schools, (c) the extension of the public school program both upward and downward on the scale of age, and (d) the relationships of the public schools to the kindred social welfare services. Three other equally

important areas are also mentioned: (a) federal relations to education, (b) the evolution of state systems of school finance, and (c) the changing relationships between public school authorities and state and local noneducational fiscal authorities.

Three to four hundred decisions of cases involving one or more discrete issues in school law are handed down by the higher courts of the states and the federal tribunals each year (103). The number of cases in the lower courts of record is, of course, much larger; and in a single populous state, such as Ohio, the attorney general's office renders about one hundred opinions on school law questions annually.

Important to the improvement of the quantity and quality of research on the legal basis of education is the assignment of appropriate personnel in graduate schools and in state education departments, and the organization of research agencies at the national level. Pre-doctoral research in school law should have the guidance preferably of professors broadly trained in education, law, and political science. In the absence of any one such member of a graduate school staff, a joint committee of carefully chosen professors in each of the three fields suggests itself.

Every state education department should have one staff member especially competent in school law, with facilities for research and publication in that field. All quasi-judicial decisions, administrative orders, and important correspondence of the chief state school officer involving the interpretation of the school statutes should not only be kept in files available to the public for legitimate purposes but also should be printed and bound at suitable intervals and made available to school personnel throughout the state. Current items of importance should be regularly published in the official periodical of the state education department. The cost of these services would be more than recouped in the lessening of unnecessary correspondence and the reduction of needless uncertainties in the minds of local schoolboard members and superintendents and teachers throughout the state.

At the national level some commendable but necessarily fragmentary research is carried on by the United States Office of Education, the National Education Association, the American Council on Education, and other agencies; but in each of these the assignment of personnel and the facilities for publication are as yet too limited for the type of fundamental and continuous attack which the broad field of American school law merits. There are some possibilities of better coordination of the present work of the several existing agencies, but the best hope for the development of a more nearly adequate service rests in the evolution of some one office, sufficiently supported from governmental or philanthropic sources or both, with directing personnel, staff, and facilities for research and publication commensurate with the great significance to our democratic society which inheres in the evolution of the legal basis of education throughout the nation.

The Place of Legal Research in Education

A composite statement on the importance of research in school law may be had by juxtaposing four brief quotations. The first is from Alexander (97: 200):

The world over, law has a unique value for all concerned with social institutions like the school. While much hasty and unwise legislation passes in many countries, nowhere outside the law, which Woodrow Wilson defined as "crystallized custom," are the principles of human relationships so well stated. Accordingly, the educator concerned with securing fundamental principles for any phase of education will do well to go promptly to the chief legal formulations of conduct involved.

In the United States, law has another great importance for the educator. It represents the aspirations of the American people.

The second is from Cyr and Cunin (108: 509):

Legal research constitutes one of the important fields of educational research. Public schools and school districts are in the last analysis creatures of the law. Their administrative structure, functions, and authority are dependent on laws and legal decisions. With forty-eight states each developing its own legal system, in addition to the federal government, a wide variety of educational practices has developed during the last century and a half. Examination of the historical development of school law in the United States and comparative studies of the legal provisions in the different states, as well as regional differences throughout the nation, offers a rich field for the educational research worker. . . . Such research is needed to provide a body of knowledge for those who are charged with the responsibility of making new laws and modifying old ones.

The third is from Good, Barr, and Scates (114: 270):

Although the concern of the school administrator and board member with school law is apparent, the interest of the classroom teacher in such problems can be justified without much difficulty. The right of the teacher to control children going to and from school, the teacher's liability for injury to children while at school, and the influence of the courts upon the curriculum are all legal problems. There seems no logical reason why teachers and field workers should feel limited in their investigations to studies of presentday teaching methodology and curriculum reorganization.

The fourth is from Chambers (100: 1, 19):

Hitherto the two professions of education and law have developed, for the most part, quite apart from each other. Each has its own literature, its own bibliographical methods, its own technical vocabulary, and its own methods of approach to research. For most of the members of either profession, the other is as a closed book not to be opened—as an unfathomable mystery not to be explored by anyone other than its own professional devotees. Every student of human relations today can observe that this compartmental exclusiveness with which different departments of human knowledge have developed must be to some extent broken down if we are to produce leaders who are able to survey and comprehend the complex problems which overlap into all the fields of social science. Consequently, the student who ventures into the field of school law may be assured that he is undertaking a real service to the advancement of knowledge. One who works in this area should set for himself the goal of mastering the methods and meeting the standards of both professions insofar as they apply to his own scholarly work. . . The field of school law is immense and largely unworked.

Edwards (109) contributed another excellent exposition of the basic nature of the American law of public schools, too extensive to permit of summarization at this point.

CHAPTER IV

Quantitative Analysis of Documentary Materials¹

EDGAR DALE

THE HISTORY OF EDUCATIONAL RESEARCH discloses many quantitative studies of the content of textbooks, errors in grammar and spelling, analyses of technical and nontechnical vocabularies, the mathematics used in everyday life, and the like. This general area of research was summarized, with illustrations, by Good, Barr, and Scates (133). They recognized textbook analyses, analyses of large bodies of literature, activity analyses, vocabulary analyses, error studies, and analyses of record and report forms. To these we should probably add the quantitative analysis of motion pictures.

Limitations of Quantitative Documentary Analyses for Curriculum Making

The value of such studies for curriculum building has been questioned by some who believe that little educational guidance can be secured from them. The questioning may be valid if one assumes that the results of these analyses are to be taken directly as objectives of instruction. But it is only when they are regarded as data to be used as a suggestive guide in formulating certain of the objectives of education that they have significant value. For example, the teacher or curriculum maker should know the names, places, and events frequently mentioned in periodical literature. Yet these do not immediately become the goals of learning. They must be subjected to logical analysis first.

One of the objections to the use of results from such studies is that they yield "status" data. Bagley (120) made this clear in his comment on his own study of geographical references in newspapers and magazines. He said:

... any method that attempts to utilize literature as a criterion for the selection of educational materials should be applied with a distinct understanding that it may simply result in a circular form of reasoning: current literature of a "general" nature is likely to represent pretty accurately "general" education. In some respects, it is just as valid to infer from the content of the school program what the character of current literature will be as to infer from the character of current literature what the content of the school program should be. Certainly, if there is a causal relationship, it is from the school to current literature, and not vice versa. (120:133.)

A second objection to analyses of literature, of errors, or of activities is that one cannot infer importance directly from frequency. A third objection is that such studies tend to place an emphasis on the more mechanical aspects of learning and fail to reveal the need for learning the more dynamic elements of behavior. There are other objections also. They are discussed at some length by Good, Barr, and Scates (133) together with the entire problem of interpreting such studies.

¹Bibliography for this chapter begins on page 595.

It should be noted that frequency counts of documentary material may be put to some very different uses, which avoid most or all of the criticisms referred to above. These will be mentioned later. We shall proceed to some of the technical problems of frequency studies.

Delimiting the Problem and Classifying the Cases

When data of the discrete type considered in this chapter are collected and analyzed, it is imperative that the problem and its limits be stated with extreme clarity. In the field of spelling, for example, it is not enough to state that the purpose of a study is to ascertain the words most commonly used in writing. Shall it be adult writing or child writing or both? Does one wish to include writing such as occurs in a diary, marginalia, or "doodling"? Shall personal letters be included, and, if so, is there a possibility of inadequate sampling of certain types, that is, intimate personal letters? Shall the writing studied include materials prepared in school on the basis of teacher assignments? Obviously, the investigator may make his study as broad as he wishes, but unless he states his limits carefully, difficulties may arise.

Classification illustrated by motion picture studies—One of the most vexing problems faced by an investigator who is collecting data is the classification of his materials, that is, what categories to employ in making his tabulations. So long as an extensive number of categories does not increase tabulation difficulties unduly, one should err on the side of completeness because one can combine categories later on if necessary. There is a good deal of room here for preliminary exploration. The writer discovered, for example, after considerable study, that newsreel materials were advantageously divided into twenty-eight categories. Furthermore, it was not difficult to train new tabulators to recognize these categories and to classify accurately the materials which they had to handle. An important element which should be considered in one's classification is the degree to which it will answer significant questions that are being raised about the object or condition studied. One common question asked about newsreels is the extent to which they are monopolized by sports and military activities. Our classification has made it possible for us to show clearly that sports are the most common in all newsreels, that war and military preparation are usually second or third in amount, and that such topics as agriculture, dairying, and ranching usually rank at the bottom of the list. This classification scheme enabled us to ascertain that in a recent four-week period over half of the newsreels dealt with war or the preparations for war, and of these items 34 percent dealt with the United States, 56 percent with the Allies, and 10 percent with Germany.

Another classification of the themes of motion picture feature films has been carried forward over a period of years (129). These data indicate the proportions of pictures dealing with the following categories: crime, sex, love, mystery, war, children, history, travel, comedy, social problems.

Classification illustrated by word counts—In Thorndike's counts of the frequency of words (142), except for very special reasons, separate entries were not made for plurals in *s*, plurals where *y* is replaced by *ies*, adverbs formed by adding *ly*, and the like. To correct for the inaccuracies involved in tabulating as the same identical words all words which are spelled alike but have different meanings, such as *bear*, a further study was made by the Institute of Educational Research, called the "English Semantic Count" (138). This analysis used the index provided by the *Oxford English Dictionary*. In deciding questions of classification one must consider the use which is to be made of the results. For example, in a spelling study where one is attempting to discover the words used by children and adults in their writing it is important to count as different words such variations as "write," "writing," "written," and "wrote." In a vocabulary analysis, however, it might be less important to distinguish between these various forms; they might all be counted under the word "write." The general problem of classification has been further discussed by Scates (141).

Stating the Assumptions

It is important that the investigator indicate the basic assumptions which underlie his study or which will attend the use of the findings. For example, if studies of the grammatical errors made orally by school children are utilized for building a grammar curriculum, it is assumed that an important function of the study of grammar is to improve speech. A subsidiary assumption is that if the most common oral grammatical errors are known by the teacher and are directly attacked in the curriculum the grammar of speech will be improved. It is sometimes further assumed that the sentence context in which grammatical errors are made is not significant; hence, only the specific errors are collected. Statistical assumptions, especially those relating to sampling, also ought to be clearly stated.

The statement of assumptions serves two important functions. It sometimes reveals to the investigator the untenability of certain of his assumptions and clarifies the problem for him. It assists the research consumer in determining the extent to which he will accept the findings, because it enables him to evaluate the assumptions.

Sampling Problems

How much data should one obtain? The answer lies in the degree of reliability which will suffice for one's purpose. It is possible in most cases to determine statistically the size of the sampling necessary to secure the desired reliability. For example, Thorndike (142), in his study of the frequency of words in reading materials, secured a measure of reliability by getting two sums from random halves of sources and computing the median probable displacement from the position that a word would have if obtained from an infinite number of such counts. He discovered that about twenty-five of the words rated in the first five hundred would be

placed elsewhere by an extensive count. Further, as Thorndike stated, "Counts of a million books would probably replace only about 1,000 of the 20,000 words by others."

Before the sampling is begun the investigator ought to list every known factor that may influence the nature of the data to be examined. For example, in the study of the vocabulary of individuals, sex, age, geographical location, and other factors are likely to influence the data. The investigator should seek to make up the sampling study in such a way as to include a representative proportion of cases falling in each category of the factors previously listed. It may be desirable to tabulate certain groups separately, as different sexes, different ages, and the like. Such data can always be combined later but cannot be unscrambled if one fails to keep them separate. Subsequent investigators may desire to make use of the separate group data. In areas such as the study of spelling or the study of vocabulary, this point is sometimes important.

When one realizes that Gallup (119) secures reliable data by querying at times fewer than 10,000 persons carefully selected throughout the United States, it is seen that the skilful application of statistical principles of sampling will often eliminate the need for collecting huge quantities of data. By keeping comparable halves one may be able to determine when statistically reliable data have been secured. Furthermore, in studies seeking only percents of occurrence, one can eliminate bit by bit those cases for which adequate sampling has been made.

Tabulating the Data

The problem of tabulation can be ameliorated by these devices: (a) by having tally sheets for the most frequently appearing items close at hand for tabulation, for example, a separate checking list for the most frequently appearing items; (b) by watching the sampling carefully and stopping the tabulation for the most frequent items at a time when additional data will not significantly change the frequency proportions; (c) by experimentally developing mechanical equipment which might eliminate some of the time-consuming activities of tabulation; (d) by using available equipment, as the Hollerith electrical scoring and counting machines.

Horn (137) had spelling words recorded on sheets $8\frac{1}{2} \times 13$, indexed on the left-hand side of the sheet with beginning letters of key words such as ab, acc, add, aff, ag, and the like. Preliminary experimentation indicated the amount of space necessary between the tabs. A series of sheets indexed and spaced to hold 10,000 words was found to be most satisfactory. When the sheets containing approximately 10,000 running words became crowded, the words were then transferred to larger series of sheets holding about 100,000 running words. Each tabulation sheet was carefully marked to indicate the kind of material from which the words were taken. Horn indicated that an unsatisfactory attempt was made to use Tidyman's method of putting each word on a separate card and then sorting the cards.

Experimental work is going forward with the use of Hollerith equipment in the tabulation of errors. Greene (135) reported, for example, that more than 1,500,000 running words of the actual writing of children in Grades IV to IX have been transferred to specially designed Hollerith cards. Each card carries a single sentence and each is coded to permit the identification of the sentence, the particular composition or letter from which it is taken, and the serial position of the sentence in the composition or letter. Later it is planned to code the same cards for other items such as verb usages, pronoun usages, and sentence variety. The tabulation of these materials by sentences and with keys by means of which the original can be identified is especially important. Many of the studies made in these various fields are not easily repeated or are the data secured useful for purposes other than those for which the research was initially begun.

Various Curriculum Illustrations of Documentary Analysis

The range of quantitative studies is extensive. Bobbitt (121), with the assistance of a number of students, carried on a significant quantitative analysis of written materials in order to discover data useful in curriculum construction. This included an analysis and classification of all topics in the *Reader's Guide to Periodical Literature* covering the years 1919-21, an activity which resulted in the classification of 11,000 different topics. The topics in each of these subordinate fields was then redivided and quantitative analyses were made of these items. Bobbitt made it clear that one cannot assume that there is a significant positive correlation between the frequency with which these items are mentioned and their importance in the curriculum.

Similar analyses were made of 180 issues of the *New York Times*, 14,740 columns of the *Encyclopedia Britannica*, topics referred to by the ten thousand most frequently used English words, topics treated in the *Literary Digest*, and others.

Pierce (139) made a study of the civic attitudes as disclosed by the analysis of American school textbooks. These books included 97 histories, 67 books on civics and social and economic problems, 45 geographies, 109 readers, 10 French books, 4 textbooks in Italian and 7 in Spanish, and 50 music books. The books were surveyed to discover the civic attitudes presented to people who read them. It should be noted that the significance of her data depends largely on the assumption that the textbook is one of the chief agencies of instruction in subjectmatter.

Charters carried forward a number of curriculum studies making use of quantitative analyses. These include, among others, *The Commonwealth Teacher-Training Study* (126), his study of secretarial duties and traits (124), and his study of basic material for a pharmaceutical curriculum (125). Charters made clear in these studies that such findings are raw materials for curriculum construction and that evaluatory judgments must

be expressed in reference to them before they finally become a part of a curriculum.

Caution—One must be continuously on guard against assuming that the frequency of appearance of an item, whether it is a grammatical error, the most frequent type of arithmetical operation, or the most commonly misspelled word, dictates clearly and unequivocally what the educational treatment of that situation shall be. To accept such a conclusion is to fall into a narrow, mechanistic concept of education. Objective data secured in the quantitative studies which have been described must in turn be qualitatively and subjectively handled by teachers, textbook writers, and educators in order to determine the learning situation in which they are to be used.

Indexing Difficulty and Trends

Dale and Tyler (131) analyzed health materials to discover factors which might correlate with the reading difficulty of such materials as experienced by adults of limited reading ability. The number of hard technical words, hard nontechnical words, and the general complexity of sentences were among the three highest predictors of reading difficulty. Other analyses were made of length of sentences, parts of speech, types of pronouns, and beginning letters of words. Similar studies were made of reading materials by Gray and Leary (134).

Brownell (122) studied the research on sixty-seven problems in arithmetic. By a system of tabular cross classification he showed the extent to which nineteen different research technics have been employed in solving these problems. One notes, for example, that the testing technic has been used 125 times in these studies, the laboratory technic only twenty-two times. Analyses of research such as these are extremely useful to workers in the field.

Several chapters in the study, *Recent Social Trends* (140), illustrated the analysis of trends in social phenomena. We may cite the work of Willey and Rice (146) on changes in the amount and kind of communication, based on an analysis of materials handled by the post office and by telegraph companies, and developments in the field of periodicals, newspapers, and radio programs. Hart (136), in discussing changes in popular interest and in certain attitudes, counted the number of articles which had appeared in certain classes of magazines indicating the views of authors and the supposed interest of the readers.

In the field of analyzing moving picture films taken in the laboratory, we have yet another type of documentary analysis. In this instance the film is used primarily as a means of observation and recording; it is not an example of meaningful content of ordinary communicative documents. For the analysis of eye movements in reading, we may cite Tinker's bibliography (143) of this field, and for a more recent use—the analysis of viewing art work—we may cite Buswell's study (123).

CHAPTER V

Direct Observation as a Research Method¹

ARTHUR T. JERSILD and MARGARET F. MEIGS

DIRECT OBSERVATION is the oldest, and remains the commonest, instrument of scientific research. Its systematic use in research in child development and education has become especially prominent during the past fifteen years. Several factors have given impetus to its use, including the establishment of centers for research in child development; the demands of the "newer education"; a desire to probe aspects of behavior not accessible to the conventional paper and pencil, interview, or laboratory techniques; a desire to obviate some of the subjective errors likely to enter into the customary rating procedures; an emphasis on the need for studying children in "natural" situations, and for studying the functioning child, including his social and emotional behavior, rather than to rely exclusively on static measurements of mental and physical growth.

The present report will deal primarily with applications of direct observation procedures since about 1925-26, when Olson and Goodenough, shortly followed by Thomas and others, focused attention upon the method itself, its possibilities, and the procedures and safeguards necessary to establish it as a reliable scientific tool. For earlier reviews and discussions, see Olson and Cunningham (190); Good, Barr, and Scates (163); Goodenough and Anderson (165); Murphy and Murphy (185); Anderson (148); Bott (156); Arrington (151); and Symonds (197).

Development of the Method

Olson (187), in an investigation of nervous mannerisms of children, "attempted to apply the general principles of scientific measurement as evolved in biometric work to observations of behavior." He applied what came to be known as the "time sampling technic." The method was further explored by Goodenough (166, 167), and Parten (191); by Thomas and associates (199), Arrington (149); and by numerous subsequent investigators (154, 156, 170, 173, 175, 176, 178, 184, 186, 198).

The details of procedure and the practical recommendations emerging from studies designed to develop the scientific integrity of direct observation have varied, but certain requirements may be noted, including systematic recording in objective terms of behavior in process of occurring, in a manner that will yield quantitative, individual scores according to procedures that involve the following safeguards: (a) definition, in terms of overt action, of the units or patterns or contexts of behavior that are recorded and scored; (b) measurement of the objectivity of definitions so used; (c) "control" of the observer; (d) measurement of the reliability

¹Bibliography for this chapter begins on page 597.

or fidelity of the observer; (e) appropriate timing and distribution of observation periods; and (f) observation periods that are sufficient in duration and number to give a reliable sampling of the behavior with which the study purports to deal and for which quantitative results are reported.

In many of the earlier studies, the units of behavior were defined in advance, and the observer could then enter a check or symbol on the record each time an item of a given category occurred. Predetermined categories of this type have been utilized in a number of subsequent studies, and have been found adequate for many purposes.² Many recent studies, however, while retaining the measures of objectivity and reliability, have abandoned the use of fixed, predetermined categories in favor of a more fluid "running account" of what is happening. As indicated in a study by Jersild (176), the use of predetermined categories to probe restricted aspects of complex forms of behavior may fail to yield data that authentically reflect what transpires. As has been indicated in several studies, a procedure obviously fails in achieving its purpose if objectivity, in a literal sense, and reliability, in the statistical sense, are gained by sacrificing more and more of the substance with which a study purports to deal (154, 175, 176, 185, 186). Further, for many purposes, it is more important to consider given items of behavior in terms of their context and the pattern of which they are a part than to obtain simply an accumulation of isolated tallies (160, 177, 186). There are pitfalls in this direction, also. A procedure so highly skeletonized that it yields only a few dry bones is no more to be avoided than a treatment which becomes so entangled in fine shades and nuances that nothing emerges save a lengthy and quite inconclusive volume of chitchat about each individual who has been observed.

Situations to Which the Method Has Been Applied

Direct observation has been used in studies of practically all aspects of the behavior of young children, and it has been quite widely applied in classrooms, camps, homes, discussion groups, playgrounds, museums, studies of the behavior of adults, and special situations (see preceding footnote).

The method of direct observation has been applied in situations that are "free" (with no restrictions other than those normally inhering in the situation itself); or manipulated (as when the investigator, in order to precipitate given types of behavior, injects a special or arresting factor) (186); or partially controlled (as when children are confined to a given

² To conserve space, illustrative materials and numerous references had to be omitted in the final draft of this and other sections of the paper. An indication of some of the problems that have been studied by adaptations of the method of direct observation can be found in the bibliography, which exceeds the number of references specifically mentioned in the text, but does not list several important studies, including several numbers of the University of Toronto *Child Development Series*; the University of Iowa *Studies in Child Welfare*; and the University of Minnesota *Institute of Child Welfare Monographs* (in several of which effective use has been made of semicontrolled situations); and *Child Development Monographs*, Teachers College, Columbia University (including several studies utilizing predetermined categories and a later group utilizing the "running account" procedure in free or partially controlled situations).

room or situation or are confronted with certain conditions or directions, with freedom to respond to such conditions in their own way) (147, 160, 172, 173, 182, 183, 184). Many studies have utilized both free and controlled situations (172, 173, 186). The method can also be used to study behavior appearing incidental to a situation that definitely confines the individual, for example, observations of accessory movements exhibited when a person takes a mental test (152).

Mechanics of Recording

Technics of record-taking range from the use of standardized record sheets constituting, in effect, a checklist, and ruled off to accommodate predetermined categories of behavior and units of time, to the use simply of a blank pad of paper on which the observer records as fast as he can as much as he can hear or see. There are many intermediate procedures: categories of behavior may be recorded (usually by code) in a running account; the checklist form may be combined with space for supplementary running comment; the "running account" or "diary record" type of recording usually will involve the use of many abbreviations and symbols, and it may combine the recording, by symbol, of certain predefined units of behavior along with a more fluid account of the context in which such units of behavior occur.

Experiments have been made with mechanical aids in keeping account of the passage of time during the observation period (150, 196, 200, 202). In situations corresponding somewhat to those in which the method of direct observation applies, use has been made of mechanical aids in recording (153, 169). Much use has also been made of photography and motion pictures (162, 188). In many situations there are features of behavior that cannot, with present equipment, adequately be recorded by means of motion pictures (by reason of problems of lighting, mobility, time, and the like). Sound films have been used as a means of studying the accuracy of observers (150, 198).

Longhand and shorthand accounts have been compared with each other and with mechanical recordings (153, 199). For the purposes of a given study, the efficiency of the observer may depend less upon speed of writing or degree of fidelity in reproducing minute details than upon the worker's "style of observation and the amount of selectivity" which he exercises (157).

Definition of Units of Behavior and Scope of Observations

In practically all situations it is necessary for the observer to be selective; he cannot see and record everything. Whether the object is to obtain considerable detail on a limited aspect of behavior or to record the occurrence of gross types or patterns of activity, it has been found necessary to plan what the emphasis will be, what especially will be noted,

what is to be ignored or simply to be noted in general terms. Unless the investigator is reapplying procedures developed in earlier studies, the usual practice has been to do a great deal of preliminary exploration.

In any event the investigator finds it necessary, sooner or later in the course of the study, objectively and in some detail to define the units or categories of behavior in terms of which he proposes to produce quantitative data, and he must take steps to measure and to report the results of his measurements of the objectivity of his definitions.

A frequently used test of the objectivity (and applicability) of a set of categories is to have two or more independent workers classify the contents of records of the behavior that is being studied. (In the exploratory stages of a study, a worker can measure his own consistency in classifying the same data at different times. If he cannot even agree with himself, it is apparent that his scheme needs revision.) Item by item comparisons of the analyses can then be made, and the agreement can be computed in terms of percents. In practice, this process may have to be repeated several times with progressive refinement of definitions, removal of ambiguities, and contraction or extension of the list of separate categories or behavior units. This procedure obviously does not demonstrate whether the categories eventually chosen are the best that might have been chosen, but if carefully carried out it does mean that definitions are made explicit, that hidden or subjective considerations are substantially eliminated, and that other investigators in the same field can either utilize the same definitions or demonstrate, objectively, what their defects may be.

Among other matters that investigators have been called upon to define are the criteria as to what constitutes a new or discrete occurrence of the behavior in question. (This problem is obviated, to a great degree, when scores are computed in terms of time units, as shown below.) For example, opening the door for another and helping another to carry a load may each fall under the definition of cooperative behavior and receive a separate tally when occurring at different times; but if both occur together in a single episode, or if one of the acts is repeated in immediate succession, should one or two tallies be given? The answer may have to be somewhat arbitrary but it can be explicit. Similarly defined must be the ways in which the same event might be tallied under different headings or sub-headings; for example, Jack runs up and punches Jill's nose—this is an instance of "aggression" and it represents also a "social contact," not to mention many other things.

The choice between predetermined categories and the "running account" type of record has been made, in part at least, on the basis of the investigator's purpose. The former procedure has been found expedient when the intention is to obtain a quantitative survey of the frequencies of certain clearly definable and psychologically distinguishable forms of behavior. The disadvantage, of course, is that once the units have been decided upon,

the observer is not free to adapt his account to what he observes; rather, he must fit what he observes to his categories and this sometimes may mean that he is compelled to project his own definitions on the behavior that he sees. For varying viewpoints on this subject, see (151, 154, 157, 165, 177, 185). In the running account, the worker, in devising his final scheme for treating the data, can capitalize on the contents of his records as well as upon incidental learnings during the course of his observations. Both procedures involve the danger of shifts of emphasis during the course of the study, and neither is proof against the development of bias on the observer's part during the study (149, 157).

Time Units

The time unit within the observation period is especially important if it serves as a scoring unit, as shown below. Observers have used time units ranging from five seconds to several minutes. The necessities for refined time units will vary with the nature of the behavior that is being studied. A gross time unit may not be sufficiently discriminative, and on the other hand a highly refined unit may not only be unnecessary but meaningless, especially in the study of behavior that occurs relatively infrequently (166, 189), and it may interfere with accurate observing (151). Even when time units are not used as a basis of scoring, investigators have found it useful to have a record of the passage of time, say in units of thirty seconds, or one or more minutes; such timing is handy for orientation when comparisons are made between records of independent observers, for sectional treatment of the data in measurements of reliability, and for possible supplementary analyses in the final treatment of the data.

Quantitative Units Used in Scoring

Scores may represent a tally of the frequency of a given response or defined unit of behavior during the entire time devoted to observation, for example, the number of different times a child recites (171, 178) or the number of different times a given language construction is used (183). Or they may represent the number of separate time units during which a given response has occurred; for instance, in a record which notes the passage of time in units of five, ten, thirty, or more seconds, a tally is given for each unit during part or all of which a child laughs, or is physically active (149, 177, 187). For some purposes it is important to take account not only of the frequency of discrete responses but also of their extent or duration (for example, to distinguish between a lengthy recitation and a brief "yes" or "no").

In connection with some forms of behavior, it has been noted that gross frequencies alone may fail to tell the whole story. Further, it may be appropriate, in interpreting the data, to take account of occurrences that may be revealing, even if rare. Likewise, relative frequencies may be as important

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as absolute frequencies, for example, A exhibits 30 "social contacts" and 10 "conflicts," while B exhibits 60 "social contacts" and 15 "conflicts"; the difference between the two in number of "conflicts" may be much less significant than the difference in ratio of friendly to belligerent social contacts (177).

Length of Separate Observation Periods

Single observation periods have ranged from less than a minute to several hours, depending on the predilection of the investigator, the nature of the phenomena that are being observed, the convenience of all concerned, or practical restrictions and routines (such as length of the class period). In some situations the periods necessarily will be of variable length—time spent by observed child in taking a mental test, in dental chair during treatment, in taking his afternoon nap, or time taken by different children to exhibit a given number of responses when the sampling desired represents the number of responses rather than a constant time interval. In the study of the behavior of young children, especially in "free" situations, a series of many short, rotated periods (ranging from five to fifteen minutes) may insure a representative sampling better than a smaller number of longer periods. The optimum interval is likely to vary with different types of performance (166). However, a short look-and-run observation may come upon a sequence of activities that already is under way, forsake it before it is concluded, and thus miss important features. Decisions here, as in connection with other features, will usually represent a compromise between the ideal and the practical. In planning the length of the observation period it is proper, among other things, to provide as far as possible for breaks or rest periods, since the job of observing often is quite exhausting.

Measurements of the Reliability of the Observer

To meet the requirement that for each feature that is treated quantitatively in the statement of results there must be a measurement of the observer's accuracy or fidelity in noting and recording this feature, a common procedure has been to compare, item by item, the records obtained when two or more independent workers simultaneously but independently observe and record the same behavior. The agreement can be computed in terms of percents.³ Where feasible, the observer can similarly be checked against a mechanical recording of samplings of the behavior that is being studied (150, 153, 198). When predetermined categories are used, measurements of

³Two formulas have been used: (a) items on which observers agree divided by this value plus items of disagreement (including items dissimilarly recorded and items noted by one observer and omitted by the other); (b) items in each observer's record that agree with the other's (in effect, doubling the agreements) divided by this total plus disagreements. For a discussion of the reasons underlying the latter, see Arrington (149). For illustrative findings regarding observer reliability see (149, 157, 167, 170, 175, 187, 191, 193). Within a given study, covering several units of behavior, observer agreement on the different units may vary considerably. The lower the agreement, obviously, the less confidently can the investigator report quantitative findings for the behavior in question.

observer agreement and agreement on classification are, in part, telescoped (151).

The measurement of observer reliability is somewhat simpler when observations are recorded in terms of a predetermined list of categories than when a "running account" is made. However, even when the latter scheme is used, there must be an understanding, before the observer begins to take records that represent the main data of the study, as to the points of emphasis in the observations. Item by item comparisons can be made of the specific content of the records of independent observers, even though the investigator may not yet have reached a decision as to how given items of behavior, reliably recorded as far as can be determined by measurement of agreement between independent observers, are going to be classified and interpreted in the final treatment of the data (171).⁴ The final scheme of classification can, in turn, itself be tested for objectivity.

The correlation method has also been applied to measure agreement between the records obtained by independent workers, in simultaneous or non-simultaneous observations. For certain purposes this procedure suffices, although it may not give a precise measure of agreement; for example, in an extreme case observers A and B both record five items for Jack and ten for Jill, while a perfect reproduction would yield respective scores of ten and twenty; A may have noted items entirely missed by B, and B noted items entirely missed by A; thus, there may be a perfect correlation between gross scores but zero agreement on actual items.

Size and Reliability of the Sampling

The extent to which the data represent a reliable sampling has customarily been measured by means of correlating equal divisions of the data (for example, scores on even versus odd observation periods, or on "direct" versus "indirect" records, and the like). For rough purposes, especially when observations are made of groups rather than individuals, it is possible also to measure the consistency and extent of differences between group means in successive samples.

By reason of the ease of scoring when predetermined categories are used, such measurements can often quite expeditiously be made during interim stages to determine the reliability of the sampling to date. Even if the classification scheme is not determined in advance, it has been found to be feasible to make such interim measurements in terms of tentative categories. If not feasible, the investigator will not necessarily be completely in the dark. He can be guided to some extent by other studies, by rough interim inspections, and he can veer in the direction of taking a

⁴E. g., both observers record that while John, during class discussion, is describing the route of an airplane flight to Europe, Jim interjects, "Didn't they pass over Newfoundland?" There is measurable agreement here, even though the investigator may not yet have determined under which one of several categories (such as "critical comment": "interrupts": "irrelevant remark": "volunteers supplementary information or question") Jim's response will be tallied, in the light of its context and what has gone before, in the final tabulation of the data.

larger sampling than may be needed; if in the end it proves that he has reliable data without using a given portion of his records, he can lay such records aside. In any event, investigations that have been made to date indicate that some features in the study are likely to be more reliable than others. Accordingly, he can circumscribe his final quantitative treatment in terms of his reliability coefficients and still use the remaining findings as an aid in interpretation, or announce them as tentative.

At the present time it is impossible to give a definite estimate as to approximately how much time the observer should spend in a given situation with a given problem to obtain a reliable sampling. Numerous studies of the social and physical activities of preschool children have utilized a total of from 100 to 150 minutes, in repeated samplings of from five to fifteen minutes. This amount cannot, however, be recommended as standard. Published studies show wide ranges of reliability coefficients on the basis of from about forty minutes to many hours (or even days) of observation of different features of behavior. Within a given study the reliability coefficients are likely to be higher for some categories or units of behavior than for others (149, 175, 187). Likewise, a given sampling within the same general situation may be more reliable at one age level than at another.

The question as to the minimum acceptable reliability coefficients for scientific use of observational data has not been treated systematically. Needless to say, high reliabilities are desirable when the data deal with phenomena that exhibit individual differences (as most things do). Many published observational data do have high reliabilities, although investigators have frequently been content with lower reliabilities than customarily are demanded in connection with standardized tests or laboratory measurements. Under many circumstances a well-executed observational study with ostensibly low reliability may possibly give more authentic results than does a standardized test that is more reliable in the usual statistical sense, but is less realistically adapted to the phenomena which it purports to appraise. The doughty observer, however, will not bank on this smug generalization.

Generally speaking, reliability is likely to rise with an increase in the size of the sampling, but there are limits to which the investigator can take advantage of this tendency, as when he is studying behavior under conditions that by their very nature are not constant, for example children's initial adjustments in a new situation, or behavior that normally changes with age but might change at different rates in different children.

Since the behavior of individuals may vary considerably in different situations, an adequate study of the behavior in question may require observation of the same individuals "under such a diversity of circumstances as to constitute a representative sampling of the child's daily life" (166). Failing this, the investigator obviously can indicate that individual scores hold true only within a limited set of conditions.

Position of the Observer

The observer obviously must try to maintain a position that enables him to see or hear the items of behavior which he purports to measure; if there are restrictions on his mobility, where it is necessary to move about, or if a required stationary position renders some objects or types of behavior less accessible than others, he perforce must revise the objectives or scope of his study accordingly. One vantage point may be more favorable than another (187). This factor may complicate the measurement of observer reliability. If the observer desires only a rough measure of certain characteristics or outstanding episodes, he can station himself at a strategic point and note such happenings as flow before him, without systematic attention to each member of the group.

Effect of the Observer

The presence of an observer might be expected to produce self-consciousness or other reactions that would distort the behavior which is being studied, but this factor has usually been found to be less serious than might be anticipated. Observers repeatedly report that much-observed children, as well as adults, seem quite readily to become habituated to the presence of an outsider. The observer normally is careful not to participate in the activities he is observing unless in so doing he deliberately is introducing a factor pertinent to his study. Instances have, however, been reported in which children's behavior seems to have been influenced, at least for a time, by the observer's presence (178), and a teacher or parent whose practices are being observed would be less than human if he were not somewhat affected, although the passage of time here also has a tranquilizing effect. Whatever the observer's effect may be, it is not likely to be so pronounced in the long run that the records fail to show individual differences. As time passes habitual practices and interactions between individuals in the group come to the fore, and even the first of a series of records may reveal large individual differences in types of behavior that the observed individual might especially desire to display or to conceal, which prove in later observations to be characteristic. One-way vision screens or windows may be used for some purposes (147, 168, 172), but in many circumstances it would not be feasible to conceal the observer. The eavesdropping technic can be duplicated to some degree in "free" situations when the observer or auditor records what transpires while ostensibly he is uninterested or preoccupied with other matters (158, 181).

Scope of Observations

In a majority of published studies the observer has followed the behavior of one child at a time, but under properly defined conditions he may observe an entire group at a time. In observations of a group data may be obtained which show relatively high reliability in indicating group

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trends—in gross comparisons, for instance, between different classes studied with respect to certain performances (205)—while failing to yield reliable data for individual children (174). On the other hand, under proper restrictions, observations devoted to an entire group may yield reliable data for individual subjects; for example, in a study of the frequency and quality of pupil contributions and of the interactions between pupils and teacher, the observer may definitely center his attention only upon certain definable items that flow before the class as a whole when the group is working on a common project (178).

It might seem that individual observations require an undue amount of time in return for the results obtained. Future studies will no doubt show ways in which the advantages supposedly inhering in an observational record might be approximated by means of short-cuts. At the present time, however, the use of other methods in certain areas of behavior would not mean that the investigator is covering the same ground more quickly; it would mean simply that he was obtaining some facts and forfeiting others. It does not follow, of course, that the returns from observations have always been commensurate with the time and labor devoted to them.

In a well-planned study, data actually are accumulating faster than would appear. While observing one child at a time the observer also is obtaining an added accumulation of "indirect" data on other children if his record includes, as it often should, an account of the names and behavior of other subjects with whom the individual comes into contact or who influence his behavior in observable ways. More important is the fact that an active observer can accumulate an enormous amount of material in a relatively short time; for purposes of intensive study the data accumulate just as rapidly by means of direct observation as by practically any other means. Indeed, if the investigator is trying to get at the underlying elements of the behavior processes in question the time spent in obtaining the original records may represent only a small fraction of the amount of time that subsequently must be spent in analysis of the records. If the investigator is interested in only a limited aspect of the behavior which is recorded, the same data (if the original observations were carefully executed) may be used by himself or others for other types of treatment. Observational records of children's language (159) and the setting in which the language was used have been utilized by independent workers in various studies of language, as such, as well as in studies of resistance, aggression, imaginative behavior, and sympathy. Again, a series of "diary records" supplied data for a study of children's conflicts, and for another study of their make-believe activities; and the same raw materials might have been used for other purposes (175).

The direct observation technics abound in opportunities for cooperative research. Two persons may observe simultaneously, each concentrating on

different aspects of behavior, and subsequently pool their data (149). In a majority of studies the investigator and his associates participate directly in the gathering of the data, but data that might otherwise be inaccessible have also been gathered through the help of cooperating teachers and parents (164, 173); naturally, the more the job of observing and recording is delegated to others, the less rigid can be the control of the observation and the less can be known as to the observer's fidelity and the reliability of the sampling.

Possible Future Uses and Adaptations

Investigations to date have made only a small start in exploring the uses and adaptations of methods of direct observation. The writer does not pretend to be a prophet, but his guess is that among other developments which the future will bring are the following: considerably more use of the method in connection with the planning and appraisal of the curriculum, including, among other matters, the use of a series of observations in classrooms to provide leads as well as specific content in the construction of tests for the measurement of children's learning, concept and attitude formation, and other outcomes of given educational projects or regimes; more use of the method in connection with problems of the rearing of children at home (with the possible results, among other things, that there will be a better differentiation between problems that are a normal and perhaps salutary feature of development as distinguished from problems that require help); more use of the method in the study of theories and practices in mental hygiene and psychiatry, on both the diagnostic and therapeutic sides (with an eye to the possibility of more attention to overt action, and with the possible result that a more systematic and objective terminology may be evolved); more information, as investigations accumulate, as to how authentic data might be obtained through less time-consuming methods than now are required, including possibly the better utilization of partially controlled situations, of supplementary test and interview technics, and the use of procedures that precipitate the behavior process that is being studied, such as the "projective" method, the "play technic," and the like; more information as to how units or patterns of behavior may be defined in terms of "psychological" units or patterns; and the possible discovery, in given areas, of limited features of behaviors that may serve as an index of larger aspects.

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CHAPTER VI

The Case Method¹

WILLARD C. OLSON

PROBLEMS in human relations and in institutional management are usually presented to professional people in case form, and the published literature reflects the search for practical answers rather than scientific generalizations. The latter, however, may develop naturally out of case materials, as will be explained later. A case study may involve the use of any of the special methods discussed in the present issue of the *Review*. The unique features of the case method are the synthesis of many types of data, interpretation in accordance with known principles as modified by the dynamics of interrelationships, and generalizations in terms of wholes rather than parts.

The present summary includes reports during the period 1930-39 which illustrate contributions of case method to the advancement of technical knowledge and excludes those with the immediate objective of practical help in a situation. In the three decades prior to the opening of the period of this review, the case method accounted for but 2 to 3 percent of articles and studies in education (229, 233). There was frequently a tendency to regard it as a temporary expedient, an exploratory device, or as a means of organizing data collected by other methods (211). No comparable summary of the use of case methods for the last decade has been located. Greater attention to personal and social development has given the case study of the individual a new dignity in education.

The unique importance of the method has been well stated in the following quotation from Allport (208: 390):

The method . . . is the most comprehensive of all, and lies closest to the initial starting point of common sense. It provides a framework within which the psychologist can place all his observations gathered by other methods; it is his final affirmation of the individuality and uniqueness of every personality. . . . Unskilfully used, it becomes a meaningless chronology, or a confusion of fact and fiction, of guesswork and misinterpretation. Properly used it is the most revealing method of all.

In presenting the material the writer has devoted a brief section to general descriptions of the case method and has grouped the remaining studies in terms of the services performed by the method in the establishment of professional practices and scientific generalizations.

General Descriptions and Evaluations of Case Methods

Textbooks in educational research usually devote a section to the case method. Good, Barr, and Scates (234) gave a fairly extensive bibliography for the beginning student of educational research. Culver (220) included

¹Bibliography for this chapter begins on page 599.

fifty references on case method in her bibliography of 1,509 items on methodology in the social sciences. The field of personnel relies heavily on case technics (268). The recent comprehensive outline by Preu (251) was intended primarily for psychiatrists but utilized the data of other specialists. The advocacy of comprehensive cumulative records, amenable to case study for all children in schools, is becoming increasingly prevalent (235, 265, 271).

Interviewing is usually but one of the means of securing data for case studies. In psychoanalysis and the Rohrschach method, however, the results of the specialized interview have tended also to constitute the case study. Psychoanalytic technic stemming from the late Sigmund Freud has, of course, occupied a most dramatic position in case method as applied to problems of human living. Currently, the Rohrschach, essentially an individual method for eliciting responses to stimulus figures, is receiving intensive use and scrutiny. The technic has been both denounced and praised for its subjectivity. The supporters stress its use as an art and the desire for trained interpretation and standardization has led to the creation of a Rohrschach Institute. The reader to whom this technic is novel may wish to examine Beck's monograph (213). Independent analyses of the responses of a given subject by several persons serve to describe the reliability of the technic (237). Frank (228) recently discussed the unique contribution of projective methods with an extensive bibliography illustrating the wide variety of situations which may be used for eliciting personal data. On the whole, there is a trend toward eclecticism well illustrated in a publication of the staff of the Institute for Juvenile Research (239) and in most recent textbooks and manuals.

The difficulties in securing scientific generalizations from case materials need not be discussed here. Olson (250) stated that "from the point of view of prediction and control of the growth and behavior of an individual the case study is the most scientific method now known. Reasonably large and representative samples of the population from which data are gathered in a definite manner are recognized as necessary conditions for the extension of generalizations to groups."

A. E. Wood (270) pointed out that the statistical units extracted from records may be criticized as having little meaning apart from context; that is, the significance of a factor does not lie within itself alone but in its relationship to component elements. The factor is thus robbed of some of its unique meaning when divorced from context for statistical analysis. In spite of this limitation, however, some statistical analyses of importance have been made as will be seen subsequently.

Dollard (223) made a critical examination of the life history as a scientific method. In order to use the life history for the establishment of generalizations, he stressed the fact that the subject must be viewed as a specimen in a cultural series, that biological factors should be socially

relevant, and that the role of the family in transmitting the culture and the continuous related character of development should be recognized. He evaluated a number of published life histories in terms of these criteria.

The literature on description of case method and cases is voluminous, but there is relatively little available on the unique contribution of the method to general knowledge. Selected studies have been grouped under the following heads to indicate the types of contribution that have been made:

- Statistical Summaries for Administrative Information
- Evaluation of Programs
- Social and Institutional Patterns
- Curriculum and Instruction
- Illustration and Validation of Statistical Results
- Establishment of Scientific Generalizations.

Statistical Summaries for Administrative Information

When professional persons wish to communicate to others the nature of the problems with which they are dealing, it is a frequent practice to tabulate cases under significant categories. These tabulations serve to define policies and practices. Thus, Bassett (212) analyzed 523 cases brought to the clinic at Vineland during a period of five years. The cases were tabulated to show their origin in home, school, and community, and were distributed by age and mentality in relation to the incidence of incorrigibility, sex delinquency, and physical defects. Rosenheim (253) supplied a report on the types of cases referred to the child guidance clinic of a state hospital. Fenton and Wallace (226) classified cases according to source of reference, age, sex, race, problem, intelligence, school grade, economic status, and presented interrelations between some of the factors. The function of a family agency as defined by its clients was reported by Shulman (256). Kavin (241) analyzed 100 children studied by the clinic of the preschool department of the Illinois Institute for Juvenile Research. Her description also led to the generalization that about 12 percent of a group of unselected children seem to need special clinic study and treatment.

Evaluation of Programs

The evaluation of programs has frequently rested upon the subsequent history of persons affected by them. Thus, when Berk, Lane, and Tandy (214) wished to follow up thirty habit clinic children who manifested delinquency problems before the age of ten years, they secured parent, teacher, hospital, and agency judgments on improvement and noted that the frequency of problems was reduced by about one-half. The improvement was greatest in the case of a cooperative home and agency and in those children of normal or superior intelligence. Glueck and Glueck (232) wished to gauge the effectiveness of a juvenile court that had some clinical

assistance. Their analysis of 1,000 delinquent boys revealed that about 88 percent continued offenses after the period of treatment. Among 93 closed case records of a research and guidance bureau of a public school system, Bodin (217) found that about 93 percent of boys and girls who had reached the ages of twenty-one and eighteen years, respectively, had become delinquent or criminal.

Lowenstein and Svendsen (244) evaluated the results of eight weeks of farm-camp treatment for thirteen girls and boys characterized as shy or withdrawn by a follow-up study among case workers, parents, and foster parents. Kelly (242) summarized the results with the first 800 cases admitted during two years at a psychological clinic, relating the degree of success to the specific recommendations made. The treatment results of four guidance clinics were summarized and compared by Witmer (269). The effectiveness of provisions for the mentally retarded has been studied by case records of subsequent histories (210).

Most follow-up studies utilize some feature of case methods, since the populations can no longer be found in convenient statistical groupings.

Social and Institutional Patterns

The study of group patterns existing in families, classes, schools, and communities is of large immediate and potential interest to students of educational research. Many studies of this type are included in a new journal *Sociometry* (259) and the reviewer will not attempt separate citations. An application has recently been made and reported at length in connection with a nursery school setting (246). With the tendency to define the task of the teacher as primarily lying in the field of interpersonal relations, this type of inquiry should be increasingly fruitful.

Curriculum and Instruction

Most writers stress the point of view that the unique feature of case methods is the interpretation of a variety of data collected by many technics. While interpretation rests frequently on bodies of information obtained by other than case methods, the unique aspects of synthesis are commonly taught and the interpretations of the sophisticated person are the only ones usually credited with validity.

Sperle (260) reviewed the place of the case method in the curriculum of law, medicine, sociology, and psychology as an introduction to a description of its use in the preparation of teachers in the New Jersey State Teachers College. The technic of collecting case materials and evaluations by students and faculty are included in her report.

In a textbook describing remedial and corrective instruction in reading, McCallister (245) devoted several chapters to the presentation of type cases to advance the skill of students in dealing with problems in this field. For instruction in the general field of educational guidance, Smithies

(258) earlier compiled a book of case studies of normal adolescent girls. Wallin (266) contributed a case book of classified autobiographies for instructional purposes.

Child Guidance Cases, edited by Sayles (254), presented cases for teaching purposes, illustrating the combined physical, psychological, social, and psychiatric approach. The material was intended primarily for the preliminary instruction of the psychiatric social worker. Sibley and Stodgill (257) advocated the abstracting of clinical reeducation technics as a method of training beginners in clinical psychology. Numerous guides and problem books in education adopt a case approach. Further study could profitably be made of the use of case materials in curriculum and instruction.

Illustration and Validation of Statistical Results

It is common practice to illustrate statistical findings by rather complete reports on individual cases. For example Newman, Freeman, and Holzinger (248) gave their statistical findings on twin resemblance added human interest and a qualitative matrix by a detailed presentation of histories. A similar technic was used by Terman and Cox (264) in a study of masculinity and femininity. Throughout a statistical and measurement study of failures in college, Heaton and Weedon (236) gave illustrative material gleaned from the case records of the students studied. The reader who is untrained in statistical and experimental study is permitted to become more intimately acquainted with the material by using the case method as an alternative mode of presentation.

The items of personality, mental, and aptitude schedules have usually had their origin in the direct observation and study of cases. A common technic in the subsequent validation of psychometric methods has been the contrast of clinically selected cases with normal individuals. Contrasts of this type are too numerous and readily available to need separate citation and are properly discussed under other technics. A few illustrations of the role of case studies in relation to measurement will suffice.

Fitz-Simons (227) compiled items relating to parent-child relationships from clinical and other sources and produced a checklist on the basis of evaluation by a jury of clinicians. The device was then reapplied to case material for the delineation of parent-child relationships with substantial agreement among independent appraisals.

Studies by Hill (238) and Baker and Traphagen (209) reported success in weighting items of case histories to produce quantitative scores which differentiate between problem and nonproblem groups. Weisman (267) studied the validity of predictions based on mental tests by treating each of thirty students in a high school as a separate case and following the high-school record after testing. The case approach in this study threw into relief the factors affecting performance in an individual manner which

would be effectively concealed by a coefficient of correlation between intelligence and achievement. In the field of personality study, Rogers (252) was able to demonstrate that his test for personal adjustment correlated significantly with the appraisals of case material by groups of clinicians. Furley (230) used sixty-four brief case studies grouped by age levels from six to sixteen to illustrate and validate the concept of developmental age as measured by an interest questionnaire.

Scientific Generalizations

In medical practice the accumulation of published reports of cases of particular types has resulted in a body of knowledge leading to expanding stages of generalization. Something similar is probably happening in certain of the social, psychological, and educational fields.

Perhaps one of the best examples is the series of publications by Shaw and his associates (255) in the investigation of delinquency in Chicago. His recent report on "Brothers in Crime" continued the case methods of "The Jack Roller" and "The Natural History of a Delinquent Career" in a report of a fifteen-year study of five brothers with rather complete official, clinical, and autobiographical records. The report stressed the process by which the delinquent careers of the brothers had their origin and development and the limitations of usual methods of treatment in deflecting the course of a delinquent career. This series of studies leads to cumulative generalizations concerning the relative role of personality and the culture. Stressing more largely the personality approach, the autobiographies of child development by Gesell (231) illustrated what can be accomplished by a clinical case method following children through time. The publication of longitudinal individual data from the Harvard Growth Study (221) and current analyses from the Child Development Laboratories of the University of Michigan (249) and other centers indicated further possibilities in the analysis of material in terms of total individual pictures.

Prior to the period of this review, Terman and his associates had made extensive use of biographical case material and records in the investigation of genius. The last volume of the three, *Promise of Youth*, again utilized case material as a fundamental method (263).

Bühler (218) compiled biographies, diaries, correspondence, and records of achievement of outstanding American and European persons of the past two centuries. With this material as a basis she classified the life periods into describable epochs of growth and decline in biological and psychological functions.

By machine analysis of an accumulation of clinical cases, Ackerson (206) was able to make an extensive description of the stream of human material passing through the Institute of Juvenile Research. In subsequent studies he has developed technics of cluster analysis illustrating grouping

of symptoms for significant clinical entities. Thus, with Jenkins (240) he took fifty-seven cases with a diagnosis of encephalitis from a group of 5,000 and correlated 200 descriptive items with the diagnosis. This technic yielded change of personality as one of the most frequent and highly correlated symptoms, with listlessness, quarrelsomeness, irritability, and other characteristics in decreasing order. Similar correlations were worked out for physical conditions, school records, home conditions, sex problems, and eating habits.

The recent work of Murray and his associates (247) at Harvard is promising for important generalizations from the synthesis of data from many sided case studies of college men.

In determining the relationship between crime and psychopathy, Erickson (224) examined the records of 1,262 male patients in mental hospitals and found that 25 percent had a history of criminality—10 percent before onset of mental disorder and 12 percent afterward.

Symonds (262) obtained thirty-two pairs of case studies from former students. Each pair dealt with one child that had been accepted by the parents and one child that had been rejected. The generalization is reached that the accepted child has every chance to develop into a well-balanced, emotionally stable adult, while the rejected child is destined, on the average, to show strong aggressive traits, to be hostile and antagonistic toward those with whom he must have dealings, and to develop tendencies which may lead to delinquency.

Albright and Gambrell (207) found in the personality traits of case studies of adolescents significant material for the prognosis of the success of psychiatric treatment. Seeking an answer as to why children discontinue child guidance treatment, Feldman (225) analyzed and discussed such factors as age, source of referral to the agency, patient's personality traits, patient's attitude toward treatment, parental attitude toward treatment, parental personality traits, and reasons for children discontinuing treatment as seen by the case workers.

The more unique an event the greater the demand for a case approach. Thus, research of the Dionne quintuplets is proceeding by individual study of each of the girls as well as by what might be termed a case study of the setting for the group as a whole (215, 216). The data obtained at the birth of these children were highly significant from the biological point of view. The growth data and careful observation of the effects of training present a rather crucial test of the extent to which the environment through time will alter the fundamental pattern or status of the five children.

The pages of the current number of the *Review* could easily be filled by a discussion of the numerous studies reporting interrelationship and trends in the field of clinical study.

In closing it should be noted that the case method is practically mandatory for the student interested in process rather than product. A test will measure the number of arithmetic problems solved correctly or incorrectly, but it requires direct observation by the investigator and verbalization on the part of the child to note the steps that lead to incorrect solutions (219). It is one thing to measure information in American history and another to describe the nature of the difficulties encountered in securing comprehension (222). Schedules will measure extroversion-introversion, ascendance-submission, and other personality qualities, but observation of cases in settings are needed to delineate the process of personal-social interactions (243).

Summary

The review of case methods indicates clearly that practical necessity has led to their development, since many of the problems of human living are presented in case form. The best study of cases requires mastery of practically every technic known for the study of the individual and society. Reliable and valid work is exacting in its requirements for training and insight. Case methods present a severe test of the maturity of the art and science of human relations. The contribution of the case approach to administration, evaluation, analysis of social and institutional patterns, curriculum and instruction, the illustration and validation of statistical approaches, and the establishment of scientific generalizations indicates substantial progress in the past decade.

CHAPTER VII

Genetic Method¹

KAI JENSEN

Introduction

THE GENETIC METHOD is used in long-time investigations to discover and study the origin, trend, rate, direction, and pattern of development in the phenomena studied. It is often thought of as pertaining primarily to physical and anatomical growth but actually it is being used increasingly for the study of mental, social, and personality characteristics as well. The genetic method cannot be separated with precision from the historical or case history method, but it differs from the historical method in that it is more concerned with current developmental sequences, and it differs from the case history method in that it studies normal as well as atypical phenomena and it is not so likely to fail to consider the negative instance. As a problem-solving mode of attack it makes use of many other methods, such as the normative-survey, the experiment, the causal-comparative, the observational, the rating, or any other which will help it attain its ultimate objective of the prediction and control of individual development.

The longitudinal or seriatim procedure is often identified with the genetic method and contrasted with the cross-sectional approach. Actually, the genetic method encompasses both. Developmental sequences may be secured by either method although it is obvious that the procedure which utilizes successive measurements on the same individuals may give a more accurate picture of developmental sequences than does the cross-sectional attack. The essence of the genetic method is that it does not study any given cross section of growth or development, or level of behavior, for its own sake but seeks to discover developmental principles represented by a particular cross section in relation to other cross sections. Critical descriptions and evaluations of the genetic method will be found in Good, Barr, and Scates (310) and in Munn (350).

Problems Attacked by the Genetic Method

Any method is valuable and vital in proportion to the extent to which it yields solutions for significant problems. It is relatively weak or useless if it either attacks problems of little import or fails to yield needed answers. One field in which the genetic method has been used extensively is in the securing of growth and developmental norms of all sorts. At present its use is being greatly extended in the field of research which seeks to discover and evaluate the factors influencing various aspects of growth and development. Relatively unexplored fields for which the genetic method is peculiarly suited are the study of experimental modifications or alterations of behavior, and the investigation of origins and causes of behavior.

¹ Bibliography for this chapter begins on page 602.

A long list of problems urgently in need of attack by the controlled longitudinal approach was published by the National Society for the Study of Education (322).

Normative Developmental Studies

Many studies of the various component parts of the complex growth process have been completed. Some of these studies have been made in terms of developmental level while others have been done in terms of particular segments of behavior. Research dealing with developmental sequences in the prenatal period has been excellently reviewed and evaluated by Carmichael (287). Children after birth have been studied from many angles, and developmental sequences in the physical, motor, physiological, mental, and social realms have been published (279, 284, 285, 286, 293, 298, 303, 305, 309, 330, 347, 359, 374, 396, 397). In addition, developmental studies of thinking and reasoning (282, 289, 296, 329, 342, 353, 360, 363, 366, 388), aggressiveness (274), sympathy (351), sociability (327), dressing behavior (275, 333), fears, (325, 328), eating behavior (307, 308, 319), sleeping behavior (305, 306), and language (283, 317, 324, 339) have also appeared in the literature. Lindsey (336, 337) and Smith (383), have published developmental studies of the human electroencephalogram.

Critical Evaluation of Normative Studies

The above research dealing with developmental sequences has been carefully done and the norms secured are probably reasonably accurate for the culture pattern in which they were secured. These norms are of particular value in dealing with groups and may also be very useful in helping set the stage for optimum learning by helping evaluate the maturity level of the child (352). It must, however, be definitely recalled that these norms, in whatever field they may be, are affected by many factors. Thus cerebral birth injury (297, 356), prematurity (372, 373), restricted or accelerated practice (294, 295, 326, 340, 341), conditioning (318), praise and competition (332, 358, 398), home conditions (278, 301, 314, 315, 349, 359, 382, 386, 387, 391), conflicts (273, 299, 313), and maturity levels (352), singly or in combination, may markedly alter the ascertained behavior levels in a particular child or in groups of children. Consequently, any norms on child growth and development, no matter what aspects may be involved, are not final but are the end product of a particular set of circumstances which, if altered, may produce entirely different results. Too much research in this field has been purely descriptive in character and concerned with the mere determination of the child's present status, whereas the real problem should deal with the ascertainment of the specific factors which have produced the particular results at hand and which will modify future development.

Genetic Studies Which Deal with Various Gross Environmental Factors Which Influence Growth and Development

Some striking studies dealing with the effect of various gross environmental factors, such as socio-economic background, nursery schools, orphanages, and foster homes, on the mentality of the child have been made (280, 335, 357, 371, 377, 378, 379, 380, 381, 384, 393, 394, 395, 396). These studies seem to indicate that enriched environment may produce a marked change in the intelligence test score of the youngster under consideration and that these gains tend to persist. All the experimenters are not in agreement and decidedly conflicting interpretations have been offered. Whether or not there has been a change in the central nervous system of the child or whether the experiments show the unreliability of intelligence tests at the preschool level or accurately measure spasmodic and fluctuating growth can only be settled by the development of new experimental technics and further experiments.

One theoretical point needs to be mentioned. There is a commonly accepted belief that if a trait is hereditary nothing can be done about it. This point of view arises from a misunderstanding of the nature of experiments in genetics. In this field environmental factors are presumed to be held constant so that differential manifestations of the germ plasm may be studied. A good experimenter in this field strives to be able to say that heredity alone played a differentiating part in the observed results; he must show that environment did not produce the obtained outcomes. Uncritical nongeneticists and some geneticists have construed this situation to mean that changing environment would make no difference. Actually, heredity may set limits of development, but no one knows what those limits are except under given conditions. As the conditions are altered the manifestation of heredity may be markedly changed (321). Clear realization of this point of view should do much to stimulate fundamental research in the entire field of child development. Some scattered studies, which need elaboration and refinement, served to show that reaction to failure (332), motor skills (340, 341), artistic ability (368), singing ability (390), and other aspects of behavior formerly thought of as more or less predetermined may be greatly modified by appropriate environmental changes.

Prediction

Several studies have been made of the predictive value of tests given in the early preschool period for test scores at later ages. Workers in this field seem agreed that the prediction value of these tests is low (277, 281, 316, 354, 355, 361). This, in part, was accounted for by the fact that the early tests were largely motor tests. Other factors which may help account for the poor predictive value were the variations in growth curves of the children under consideration. Thus, studies such as those of Shirley (374),

Scammon (370), Meredith (347), and Boynton (284) clearly showed that growth curves are not uniform or constant. This is of extreme importance, for most prediction of subsequent behavior as now practiced assumes that the growth is constant. The more carefully children are measured, the more clearly it develops that their growth curves may be highly irregular in shape. Consequently, any accurate evaluation of the child's behavior must of necessity deal with his particular developmental curve or curves. Ascertaining the stage of development, or maturity level, at any one time, however, does not permit accurate predictions beyond that point for it gives no indication whether the child is going ahead, standing still, or even going backward—knowledge that is all important for prognosis. Furthermore, even if the direction of development is known, it becomes important to know the rate of development because future status obviously will differ markedly as that rate is slow or fast.

Equally important with direction and rate of growth is the matter of pattern of development. As Scammon (370), Meredith (347), Boynton (284), Dearborn and Rothney (292), and others have made clear, the different parts of the body do not grow at the same rate. Likewise, the different aspects of the child's total development vary in relation to one another. Whenever the adjustment of the child, or any other component of his total pattern is altered, other aspects of the child may also be altered. It often is impossible to measure one aspect of child development and have it stay put while any of the other aspects are subjected to change. The implications of the above considerations for research of the broad and integrated type, involving frequent reexamination of the same children, are obvious.

One interesting development in this field is the attempt of Richards and Newberry (365) to predict Gesell test scores on the basis of prenatal behavior as reported by the mother. Preliminary results are highly suggestive but cannot be taken at their face value because of the small number of subjects involved.

Methods and Technics

Technics of research in physical growth and anthropometry were reviewed by Meredith in the February 1939 issue of the *Review of Educational Research* (348). Greulich and his colleagues (312) published a manual describing in considerable detail a great variety of technics suitable for genetic studies particularly during the adolescent period. Maresh and Deming (343) compared the roentgenographical and the anthropometrical technics in the study of the growth of the long bones and concluded that the measurements from roentgenograms are superior to those from the corresponding anthropometric measurements. Pyle and Menino (362) compared the Todd and Flory bone atlases and concluded that the Todd atlas was

superior for skeletal age assessments from birth to five years of age. (This was the age range covered in their study.)

In addition to the methods and technics described in the above references and the various standard devices and instruments for measuring educational growth, the Evaluation Study (364, 389) has devised and published tests for measuring reasoning, interpretations of data, interests, and the like. A recent issue of the *California Journal of Secondary Education* (385) is devoted to a symposium dealing with the evaluation of intangibles such as critical thinking. Janney (320) has published a technic for the measurement of social adjustment.

Mathematical analyses of growth data have been made by Abernethy (272), Curtis (288), Davenport (291), Lumer (338), Scammon (369) and Weinbach (392). Jeness and Bayley (323) developed a growth equation which is of considerable value in dealing with certain types of data. Shuttleworth (376) dealt with the inadequacies of ordinary mass statistics in dealing with data of the longitudinal type and he also emphasized the special values inherent in longitudinal data. Anderson and Cohen (276) published a study showing that only those cases in a longitudinal series which are complete should be retained for tabular and graphic presentation and for statistical analysis if maximally consistent and meaningful results are sought.

Weinbach (392) used special growth equations in his study of developmental data on electroencephalograms in children. Grass and Gibbs (311) described a technical advance in the study of brain waves which consists in the use of a photo-electric analyzer which gives a "frequency spectrum" of the electroencephalogram.

If the genetic method is to be optimally useful, new statistical procedures may be needed. Thus, Jones (331) in the February 1939 issue of the *Review of Educational Research* pointed out that "it is conceivable that such a comparison, based on a parallel series of points (on actual growth curves) rather than on a correlation at one point in time or on the correlation of increments between two points, may reveal simultaneous variations, or systematic variations with constant time lags, which could not be discerned by ordinary mass statistical methods" (331: 93).

Critical Evaluation of Genetic Approaches

Although considerable work has been done with the genetic method in the field of child development, much remains to be done. For the most part, workers in the field have attacked relatively isolated problems or else have made use of inadequate technics, controls, or samples. Some of the best work has been done in collecting various norms and the resultant tendency to emphasize or evaluate development in terms of these norms is thoroughly understandable although equally mistaken. The important thing in the case of any particular youngster is not to know where he

stands in terms of group norms, but how he stands with respect to his own potentialities and whether or not these potentialities may be altered. Moreover, it is impossible to overemphasize the fact that any particular set of measurements of a youngster represent single points which tell nothing of the rate or direction of the child's growth or development. Without this added knowledge, comparative scores are distinctly misleading and predictions for the particular child are apt to be invalid. In addition to all this, it must be clearly borne in mind that even after all the above conditions have been fulfilled, the obtained evaluation of the child is accurate only within the particular culture pattern of the group of which he is a member. We really want to know what specific factors produced the particular outcomes, the extent to which they are operative, and how they may be controlled so that undesirable factors may be eliminated or minimized and desirable factors safeguarded and accentuated.

Need for Advance Planning

The fact that the best uses of the genetic method involve longitudinal or seriatim studies of the same children over long periods of time means that any errors or oversights in either planning, testing, experimentation, or final evaluation will be extremely wasteful and costly. Consequently, this method requires very careful planning, continual critical self-evaluation, and the use of the very best data-gathering devices and technics. Work such as that of Marshall (344) and Meredith (346) showing how often physical and anatomical data should be collected, and the optimal interval between collections of data, should be extended to other aspects of growth and development. Cumulative record forms of various sorts are being carefully prepared and utilized in connection with the genetic method (302). In addition it should be noted that the planned experimentation technics of Fisher (300) are being brought into the field of child development and should prove of great value. It also is important that there be very careful planning of the objectives and that appropriate measuring devices be available particularly where the research deals with the relative intangibles that are of such great importance.

Conclusions

1. The bulk of the research using the genetic method has been descriptive in character and has used the normative approach but there is an increasing attempt to assess the factors that cause or influence particular outcomes.
2. The genetic method is being used increasingly for the developmental study of the relatively intangible aspects of growth. Along with this change of emphasis new technics and methods of research have been developed.
3. The inadequacy of conventional mass statistical procedures for optimal analysis of developmental data is beginning to be realized.

4. The need to study origin, rate, direction, and patterns of development before prediction and control of child development will be possible needs to be increasingly recognized.

5. The extreme complexity of comprehensive longitudinal studies, the inability of many groups to attempt such work, the fact that the collection of developmental data of the longitudinal type requires years of careful work, work which often cannot be duplicated, makes the publication of raw data so that others may utilize them, and help in their interpretation, an extremely significant development. This publication of raw data has been done by both Dearborn (293) and Davenport (290) and should certainly be encouraged and extended.

6. In order that only duplication of research effort which is carefully planned may exist, it is necessary that research programs be made available shortly after formulation, that there be continual publication of problems attacked, techniques used, and raw data collected, in the form of progress reports.

CHAPTER VIII

The Interview¹

RUTH STRANG

THE INTERVIEW is one of the methods used for obtaining information about processes, end results, or attitudes and feelings. It may be classified somewhere between the unstructured "projective technics" and the rigidly controlled standardized test. While widely used as a counseling technic, especially for the purpose of therapy, the interview is accepted as a research technic only with reservations. In order to understand both the values and limitations of the interview as a method of collecting data, it is necessary to review its complexity, its reliability and validity, and types of researches in which it is employed.

Complexity of the Interview

In form the interview covers a range from a casual conversation to a standardized interview-test such as the Binet. It may be genuinely desultory, apparently casual, or obviously premeditated (412: 3). Its content, even more varied than its form, may be purely factual, for example, census data; or highly subjective and personal, as in a psychoanalytical interview. The persons interviewed require an infinite variety of approaches in order that the desired information may be elicited. In short, "there is an infinite number of individual differences in the interviewee, the interviewer, and the relation between the two, as well as in the setting and content of the interview. Any particular interview is influenced by a sequence of events in the past and a foreshadowing of future plans" (416). Interviewing is a complex process demanding both personal qualities and training in the interviewer (415, 420). This uncontrolled complexity must be recognized in any discussion of the interview as a technic of educational research.

Reliability of Interview Data

The concept of reliability and validity will be a function of the kind of information sought as well as of the specific method employed. It is therefore more exact to speak of reliabilities rather than reliability, for the dependability of any instrument varies with the group, with the form of the instrument, and with the skill with which it is used. With such an unstandardized technic as the interview, the problem of ascertaining its reliability is exceedingly complex. There can be no single reliability coefficient for the interview as an instrument of research. One would expect interviews of the census type to have a relatively high reliability as contrasted with interviews of the personal reaction type.

¹Bibliography for this chapter begins on page 607.

The reported reliabilities for specific kinds of interview with particular groups are few in number. Jenkins (407) tested the dependability of a series of nineteen questions by repeating the original interviews after forty-eight hours. On the average, 90 percent of the respondents named the same brand of goods on the second interview. The range for the different items was from 85 to 97 percent; the average deviation was 2 percent. In the same field of investigation, Link (408) attempted to ascertain how many interviews are necessary for results of a certain accuracy and prepared a table showing the standard deviation for samples of different sizes in which given percents of answers are to be expected. A close agreement was found between the expected variation for samples of five hundred.

The reliability is far lower for less definite and objective information. Hollingworth (406:114-23) and other investigators have supplied evidence of the variability in information obtained from the same subjects or from two comparable groups by different interviewers. The diagnostic unreliability of the interview under counseling conditions must be recognized.

Validity of Interview Data

The problem of ascertaining the validity of information obtained by means of the interview is even more complex than that of reliability. Jenkins (407) determined the validity of the information on brands of goods obtained through interviews by comparing the brands reported as last purchased with the sales slip records of actual list purchases. The agreement between the results from these two methods of collecting data was, on the average, 78 percent, with an average deviation of 10. The investigators concluded that "while one may safely assume the reliability of last purchase questions, empirical investigation is necessary for each product whenever it becomes desirable to deal with validity."

Correlations between interviewers' estimates of students' ability and their actual marks reported by Clark (402) ranged from $+.66$ to $+.73$.

In fifteen interviews with fifteen children in the sixth grade, 87 percent of 4,095 answers were identical with those given by the same children to corresponding questions in the social-distance questionnaire (421). Some evidence was obtained that these children were answering on a more rational basis in the interview than when filling out the questionnaire. It is difficult, however, to know which of these two technics is the more accurate. The questionnaire may be less efficacious than the interview so far as there is more likelihood of misinterpretation by both parties. On the other hand, data obtained by means of the questionnaire may be somewhat more objective and candid because the influence of the investigator's own attitudes upon the subject is felt less and his replies may be made anonymously (418). In some cases the individual's first quick reactions on the questionnaire may be more valid than those which are given in an interview with more thought and analysis. Moreover, individuals vary in their

responses, some giving more authentic replies on questionnaires, while others make more accurate responses in the interview situation.

Various attempts have been made to standardize the interview. Snedden (414) developed an interview technic which compared favorably with intelligence tests as a measure of mental ability. Maizlish (409) modified Snedden's disguised vocabulary test into a "Likes and Dislikes Questionnaire." Standardization of the interview procedure does not necessarily promote reliability and validity, because the highest authenticity is obtained when the approach is so skilfully varied for each individual that he will make his most habitual, sincere, and accurate response. The highly standardized interview limits the adaptability of the interviewer. Moreover, general impressions may be more significant than details of circumstances.

Psychological Limitations

Self-concern, inaccuracy of observation, memory, and judgment, as factors causing unreliability in the interview, have been studied in psychological laboratories. In the opinion of Woodworth (419), self-concern is a most difficult psychological factor to deflect from coloring any testimony except that regarding matters which are extremely definite, objective, and impersonal. If, however, the subject's self-concern is turned toward ascertaining the facts of the case, greater accuracy may be expected. Not only may the person interviewed be subject to an unconscious bias of his own but he may also catch contagious bias from the interviewer. This danger was neatly demonstrated by Rice (413). The intrusion into the data of the interviewer's preconceived ideas seriously limits the value of the interview for purposes of scientific research.

Recent experiments in the psychology laboratory of Cambridge University (405) were designed to study the effect upon the interviewer's judgment of his candidate's character, "of a favorable or unfavorable impression about the candidate given beforehand." The interviewers were five young postgraduates, all of whom had had some experience in social work. The subjects were six boys. Although the conclusions from this experiment cannot be other than tentative, several important findings and hypotheses emerged:

1. The bias introduced into instructions given to an interviewer did affect his judgment in about 40 percent of cases in which it was applied.
2. The actual influence of the bias was not recognized by the interviewers.
3. If the possibility of a bias is recognized, its influence may be combatted.
4. The general impression gained of the person interviewed might result either in a resistance to or a reinforcement of the bias.

Values of the Interview

The interview is more important in the study of attitudes than in the study of objective facts; it is more important in the study of certain processes than in the study of end results. Because of its value in the discovery of new relationships it may be appropriately employed in the early exploratory stages of researches (411:22). For example, Nestruck (410) em-

played a standardized interview technic in the study of the constructional activities of adult males. His investigation suggested possible variations of the method and throws some light on problems of sampling, validity, and reliability. If skilfully used, the interview may also be employed to obtain a deeper insight into complex problems than is possible by means of any other procedure (404). Thus, the interview is an essential technic for ascertaining the "why" of relationships and the subjective factor, possible causes, and meanings behind objective factors. It is these meanings that make educational research significant and functional.

Perhaps one reason why educational research has been so preponderantly concerned with mass investigations and end results is that research technics for the study of individuals and processes have not been adequately developed. The interview is one means of studying the processes by which pupils arrive at certain educational outcomes. Several examples will suffice to illustrate this use of the interview, one in the field of arithmetic and one in the field of reading. By means of the interview, Burge (400) made a study of the mental processes by which pupils in Grades IV, V, and VI arrive at answers in multiplication. By this method he obtained a number of errors and questionable habits not self-evident from test papers. Brueckner (399) and Buswell and Lenore (401) used the interview to obtain information about the pupil's uses of number, his interests in arithmetic, his methods of work, and his difficulties. Dewey (403:41-42) studied the nature of the reading process by means of the interview. He used a radio microphone attached to a dictaphone to obtain a permanent record of the interviews and later had the record transcribed by a typist. His recorded interviews give a more significant and intimate picture of the pupil's comprehension of a printed passage and of the stumbling blocks in the way of effective reading than any battery of tests now available.

Trends in the Use of the Interview

Eight years ago an analysis of technics used in research related to personnel work broadly defined showed that only 4 percent of the researches examined employed the interview as a technic of collecting data (417). Although a similar tabulation has not been recently made, the writer's impression is that the interview has been used more frequently during the past ten years than in the preceding decade.

Trends in interviewing procedure seem to lie in two diverse directions. In one direction is the emphasis upon standardization; in the other direction is the tendency toward presenting to the subject as unstructured a situation as possible. The trend toward standardization is perhaps justified when the interview is used to obtain quantitative facts. For the more important use of the interview in obtaining information about individuals' attitudes, values, and morale, the interviewer's flexibility and adaptability to individual differences are essential.

Many intriguing experimental problems are involved in the technic of the interview, very few of which have as yet been subjected to research.

CHAPTER IX

Questionnaires¹

FRANK W. HUBBARD

NO ATTEMPT is made in the present summary to reconsider various questionnaire studies included in the February 1934 issue of the *Review of Educational Research*. This earlier number, in dealing with the methods of educational research, touched briefly upon studies using the questionnaire and, in some instances, upon the value of the questionnaire technic.

For full treatment of how and when to use questionnaires, attention is called to Koos' small volume (428), to a *Research Bulletin* of the National Education Association (431), and to the volume on research methods by Good, Barr, and Scates (427).

Complaints

The questionnaire has the dubious honor of receiving more criticism in print than almost any other research technic. A superintendent of schools describes it as "ubiquitous, ineluctable, and a confounded nuisance" which takes time that belongs to the public. A writer in a lay magazine contends that "freedom from questions" is becoming as important as freedom of speech and press. A recent opinionnaire type of inquiry has been described by a layman as "bush league idiocy; it belongs to a selected company of the most preposterous documents since the invention of paper."

A scanning of complaints reveals these specific criticisms: (a) the number of inquiry forms is overwhelming; (b) the time required to collect and to record the desired information is prohibitive; (c) the types of questions asked are often too personal and confidential for public tabulation; and (d) the information sought cannot be reliably obtained by means of the questionnaire technic.

Investigations with reference to the questionnaire as an instrument of research correspond in some degree to the foregoing list of specific criticisms. However, the number and length of questionnaires and the personal nature of the data are not peculiar to the questionnaire technic. The interview technic can be equally ubiquitous, time consuming, and personal. Most investigations, therefore, are concerned with the fourth specific criticism, primarily questions of reliability and validity.

Reliability of Questionnaire Data

Several investigations have been concerned with the problem of whether or not the same questionnaire given the second time after an interval produces the same results. Cavan (424) had 123 pupils in Grade VIII answer a questionnaire twice with a week's interval. Between the first and

¹ Bibliography for this chapter begins on page 608.

second trials there was agreement on 87 percent of the questions. There was 97 percent agreement on factual questions about self; 78 percent agreement on attitudes toward self. For a "neurotic inventory" a total of 83 percent of the replies were in agreement on the two forms. There was no appreciable difference in the percent of agreement between boys and girls. When certain questions were selected (to form a scale to measure home background) and were assigned scores, a correlation of .81 was obtained between scores obtained a week apart.

A similar study made by Bain (422) dealt with 61 items of factual family data, factual personal data, and subjective personal material. The information was asked of 50 college freshmen and repeated again two and one-half months later. Twenty-five percent of the 3,050 responses were different in the second set of replies. The women students showed considerably greater stability of response than the men. A second experiment made use of a list of 60 items with 22 men and 28 women in the second, third, and fourth year of college. Again nearly one-fourth of the responses were different in the second trial. The greatest amount of change occurred with the subjective personal items; the least change took place with factual personal data. The greater stability of the women was found to be reliable.

Peatman and Greenspan (432) submitted 35 statements of superstitious beliefs and 35 statements of scientific beliefs (as camouflage material) to 431 colored children in the fifth and sixth grades of a New York City public school. The questionnaire was given twice to the group with an interval of one month. The retest reliability of the questionnaire was .958. Ranking the 35 superstitious statements according to the frequency with which they were subscribed to by the group on each administration, the correlation of these ranks was .97. The authors concluded that, properly devised and administered, a questionnaire on superstitious beliefs was a reliable instrument for obtaining information.

Questionnaires pertaining to health habits and health efficiency, given to children seven to sixteen years of age by Scham and Schey (433), revealed reasonable reliability. Between the two questionnaires on health habits there was a similarity of response of 92 percent; the same correspondence was also observed between health efficiency tests.

Lewis (429) investigated primarily the reliability of the replies of 216 teachers to questionnaires dealing with personal data. For the city teachers, comparisons were made between the new questionnaire and replies to an earlier survey blank; the responses of county teachers were compared with personnel records in the county superintendent's office. On the average, county teachers made 7.5 response variations; city teachers, 8.2 variations in response. Seventy-five percent of the teachers made from six to ten response errors. On the most troublesome item of the blank 96 percent of teachers showed variations; 16 percent showed variations on the least troublesome item. There was a definite tendency for respondents to seek

to place themselves in a favorable light. Questions calling for approximations, for example, number of hours of extra school duties, seldom corresponded on the two questionnaires. The investigation emphasized the necessity of clear directions in how questions should be answered. The investigator concluded that many responses on questionnaires calling for personal data are likely to be unreliable.

Validity of Questionnaire Data

Several studies have been made in the period under review to discover the conditions under which questions obtain the facts for which they are designed.

Stoke and Lehman (437) reached the conclusion that the questionnaire is "peculiarly vulnerable when employed for collection of personal information or when used with subjects who see (or imagine they see) an opportunity to advance their personal interests by means of the returns made by them." Students in seven classes in college psychology were asked to report the number of times they had taken books from the reserve desk for assigned work. It was possible to check the replies at the library desk. It was found that seven in eight students overestimated the number of check-outs. Students of A and B scholarship exaggerated the least; C and D students the most. The investigators concluded that one could not rely upon the statements of students with regard to the amount of time given to study.

Smith (435) found that, while college students varied widely on their ability to judge the length of a line, the average guess of the group was close to the truth. He also asked students and teachers to report which books they had read in a list containing a number of false titles. Twenty-six percent of the students made false statements. In another study the track records of 1,000 high-school boys as reported in a questionnaire were compared with their actual records. Validity coefficients, while higher than in most judgment studies, showed a strong tendency to overstatement. Smith concluded that questions involving judgment and personal data obtain responses colored by a constant error of overstatement.

Walker (439) submitted to 2,229 junior college students an inquiry dealing with factual personal items having to do with age, sex, year of high-school graduation, and father's occupation. The replies were checked against valid sources. The really serious differences occurred with regard to school progress, for students "do not deliberately seek the stigma of retardation."

Some investigators, conscious of the possible inaccuracy of answers to personal questions, have suggested the anonymous reply practice. Corey (425) tried an attitude test dealing with the question of classroom honesty. Two forms consisting of fifty paired items were used. In one case the students signed their papers and in one case they did not. He concluded that

"students are about as forthright in their expression when the questionnaires are signed as when they are not signed. The concern of investigators over the invalidating effects of a signature may have been exaggerated."

It is possible that validity is affected by the form in which questions are stated. Burt and Gaskill (423) used six wordings of questions with elementary-school pupils who had viewed a motion picture film. The questions were asked orally and the children wrote on their papers "yes," "no," or "don't know." More than 5,000 answers were obtained for each form of question. The six forms of questions were: (a) Did you see a ———? (b) Did you see the ———? (c) Didn't you see a ———? (d) Didn't you see the ———? (e) Was there a ———? (f) Wasn't there a ———? The results of the definite versus the indefinite article warranted no conclusions. There was some apparent tendency for the negative form to cause greater suggestiveness when categorical answers were demanded. The reverse appeared to be true in comparisons between questions in the subjective form with the definite article. The objective form, (e) and (f) of preceding list, clearly showed the greatest suggestiveness and also the highest degree of caution.

In spite of apparent contradictions among the foregoing studies, at least three conclusions pointed out by Smith (436) offer a working basis: (a) some respondents are more dependable than others, hence a few questionnaires circulated among competent people should give more valid data than a wider distribution which includes unqualified persons; (b) where respondents have standards or mechanical aids the agreement on judgment questions is high, hence the value of defining terms or supplying definite criteria where judgment is involved; (c) the opinions of a group as a whole are more valuable than those of individuals, hence the advisability of relying upon averages and other measures of group opinion.

Lack of evidence of reliability and validity—Davis and Barrow (426) reported results of a critical examination of 500 questionnaire studies extending over a period of thirty-eight years. Their analysis shows a general failure to report evidence as to the soundness of the questionnaire procedures followed. Of the 500 studies only 293 reported the number of questionnaires sent out and returned; four studies reported coefficients of reliability. Three hundred and eighty made no statement as to validity.

Increasing the Return

Close to reliability and validity in importance is the factor of representativeness of sampling. Obviously, a high proportion of return is hoped for by every investigator because of the probably greater representativeness of the responses. Various types of appeals or pressures have been used. A monetary stimulus was tried by Shuttleworth (434) in a study of adult attitudes toward the financial support of health work in New York State. In one area each inquiry blank was accompanied by a personal

letter and 25 cents; in another area only a personal letter and a stamped envelope were used. The coin area returned 52 percent of the blanks, while only 19 percent of the forms were returned in the noncoin area. Taking the cost into consideration, there was some doubt that the procedure of paying respondents could be recommended as the usual practice.

Toops (438) examined 135 questionnaire studies seeking to isolate certain factors useful in predicting percent of returns to questionnaire studies. His listing of elements for obtaining a high percent of returns can be briefly stated as follows:

- (1) Select for study a topic in which the recipients of the questionnaire are vitally interested in knowing the answer.
- (2) Send the blank to those persons who because of personal friendship or knowledge of your professional repute will feel a personal obligation to answer. Promise to provide a copy of the results.
- (3) Employ a vigorous follow-up technic designed to touch motives as viewed from the angles of recipients.
- (4) Use best possible technic in writing questions.
- (5) Circulate questionnaire in those parts of the country where replying approaches a fixed habit.
- (6) Don't tax the interest and effort of a recipient, but make it easy for him to reply.
- (7) Use objective, unequivocal, but "sensible" questions. Be chary of essay answers.
- (8) Employ advisedly such incidental pressures as "moral obligation to reply."
- (9) Send questionnaires early in the school year before the pressure of duties decreases the chances of attention.
- (10) Don't worry about the length of the blank if the rules are followed; but undue length may be a symptom of slovenly technic.

Trends and Innovations

One of the most interesting practices that has appeared in recent years has been the use of pictures and sketches in questionnaire blanks. Perhaps the widest utilization of this type of blank has been in the field of discovering the consumer opinion. General Motors Corporation has used the procedure for a number of years in ascertaining what potential purchasers wish to find in automobiles.

A most elaborate pictorial questionnaire was circulated by the University of Minnesota in discovering what alumni were doing and what their experiences have been (430). The blank included 45 printed pages of questions, 30 half-tone pictures, and 4 pages of line sketches. The four parts of the blank were: (a) earning a living; (b) home and family; (c) socio-civic affairs; and (d) personal life. Very little space was provided for written comments or items. Respondents were called upon to rate items, check

best descriptive statements, and to follow other types of replying found in so-called new-type examinations.

In addition to the appearance of illustrated questionnaires, there has been an increased tendency to use the questionnaire for a wide variety of purposes. Early practice used it primarily to collect factual data which could be treated statistically. Gradually opinion or judgment questions were introduced and many investigators compiled the replies in statistical form. As indicated in studies reviewed in preceding paragraphs, the judgment reply, and the essay reply particularly, have been viewed with some skepticism. However, the problem has shifted due to the changing use of opinion-type blanks. Recently questionnaires have been used to arouse the interest of principals in supervisory problems and the enthusiasm of high-school students in school management. In these instances the primary interest of the investigator has been to stimulate discussion—not to obtain statistical measures of conditions. Under such circumstances reliability, representativeness, and validity appear, at least to the investigators, as relatively unimportant.

A third innovation has been the increased use of "sounding out" questionnaires. Usually this means a brief inquiry form, possibly a postcard, designed to ask the recipients to participate in a more detailed investigation, or to discover conditions meriting more careful study. This procedure has been used by the Research Division of the National Education Association in several studies. Usually this procedure results in case studies rather than comprehensive surveys. The plan has the advantage of excusing recipients from attempting to fill out blanks in which they have no interest or upon which they have no information to supply. The possible disadvantage is that these selected reports will be assumed to be representative of general conditions.

CHAPTER X

School and Community Surveys¹

JESSE B. SEARS

TO VIEW A SCHOOL OR COMMUNITY SURVEY as a distinctive method of research may be questioned, and the use of the term here may be contrary to the notions of those who see in the survey not one but many research methods. This brief section is not expected to close discussion of this question. It will, however, attempt to review the research activities related to surveys, accepting the classification on the ground that there is something distinctive about the survey as a research method—the distinctive thing being that from the standpoint of its procedures a survey is somewhat more than the sum of its parts.

While a survey includes many separate studies, each of which has a special purpose, special data, special technics, and special procedures, there is also a dominating over-all purpose, and it is with reference to this that choice of data and form of treatment are determined. As a single musical note is one thing when sounded alone and a different thing as part of a symphony, so it is with studies of the curriculum of a school system, of the trend in costs, of the social composition of its staff, or of the relative efficiency of its pupils in spelling—when treated separately, and again in a survey. Alone and separately these are simple studies; properly combined in a survey, they contribute to the over-all purpose of the undertaking and concern themselves less with isolated findings. The point of emphasis in this review of research is not upon the survey movements—their purposes, development, spread, and outcome, as such—but upon the research methods they use.

Social Surveys

A social survey stands to the field of social problems—poverty, slums, crime, exploitation of workers, race difficulties—as the school survey stands to educational problems. The reason for including the literature on the social survey here lies in the similarity and overlapping of the social and the school survey movements. Every comprehensive community survey collects social data and uses methods useful in an educational survey. Since school programs rest upon social as well as psychological foundations, school surveyors have direct use for many of the technics and data of the social survey.

History—The social survey movement reaches far back in history, though the current movement in this country antedates school surveys by only a decade or two, even if we regard the work of such men as Jacob Riis, Theodore Roosevelt's commission, and Lincoln Steffens as having

¹ Bibliography for this chapter begins on page 609.

initiated the movement. The social survey commonly regarded as the first in this country was that of Pittsburgh by Kellogg (459) in 1909, while the first school survey came in 1910. From the point of view of research method, however, the earlier scientific studies of society by LePlay (460) in 1855 and by Booth (441) in 1892-97 cannot be ignored. Even now the purposes, methods, and technics of these men are in use in community surveys.

In the field of social surveys there is already an extensive literature on methodology itself, to say nothing of the many works that have dealt with the question of a science of sociology and with the surveys themselves. The community survey is one of the instruments of the sociologist, as it is the chief instrument of the scientific social worker—whose aim is social reform rather than that of developing a theory of society.

For the general orientation of one who wishes to understand this movement, mention should be made of the works of LePlay and Booth, above noted; of that by Howard (455) in 1779, to mention a very early study; of those by the Residents of Hull House (456) in 1895; by Riis (470) in 1890; and Lincoln Steffens (476) in 1904. In such investigations and in many other studies of those years will be found the foundations of present methods of community survey work. In many of these surveys where the aim was social reform rather than scientific study, one needs to look behind the interpretation for the method. In all these studies, masses of facts were assembled and analyzed. Steffens worked by the methods of a reporter and a detective. He studied cases and traced connections. Riis described and painted a picture of the life of poverty. Booth and LePlay used statistical methods. They gathered and counted facts and added them up. Incident to their work they formulated extensive schedules and questionnaires as research technics.

Recent Methods of Social Surveys

By the 1920's the movement was well established and the question of methodology began to receive more attention as such. Due probably to the social reform viewpoint, the earlier idea of studying an entire community in all its aspects gave place to studies of special features. Sometimes one or, as in the case of Harrison's Springfield survey (453) in 1920, as many as nine separate aspects of the community were studied. A noteworthy feature of methodology of such surveys is found in the use made of local talent. Here again the reform idea dominated. Not mere description or scientific generalizations, but social improvement, was the goal and for this local interest an organization had to be built up; hence, the idea of cooperation in the studies. As early as 1920 Chapin (447) published a volume dealing with methods for examining documentary sources, how to collect data, methods of sampling, types of schedules, and methods for interviews. In 1928 Petit (468) demonstrated a method for handling case

studies designed to assist in building up social welfare agencies, and Palmer (467) published an effective explanation of methods then in use, affording a helpful analysis of many separate technics.

In 1929 Odum and Jocher (465) wrote their *Introduction to Social Research*; Lundberg (461) published his study of methods for gathering data; and the Lynds (462) brought out their first study of Middletown, to be followed eight years later by a second check-up study (463). These Middletown studies are demonstrations of research clearly conceived and well carried out. If they do not open up entirely new methods in detail, they do reveal illuminating refinements and extensions of many methods and especially contribute to the concept of a unified scheme of investigating a total community situation.

As a sample of more recent works, note should be taken of Fry's book (452) dealing with technics of social investigation, of selected articles in the *Encyclopaedia of Social Sciences*—especially that by Carpenter (442); of the recent series of monographs published by the Social Science Research Council dealing with the social aspects of the depression (474); and of Young's 1939 treatise (477) on the research methods used in social surveys.

A widely varied but extremely stimulating display of research methods is to be found in the reports of the many state planning commissions. Bibliographical work in this field is well done. From such works as those of Fry (452), Lundberg (461), Odum and Jocher (465), Young (477), and Eaton and Harrison (449)—which listed some 2,700 social surveys—the literature is readily available.

School Survey Trends

During recent years there has been an increasing social emphasis in education. Curriculum changes, guidance and teaching technics, library development, playground supervision, and even the physical facilities of a school system—all reflect this emphasis. There is a movement away from emphasis upon books and upon subjectmatter as such; away from buildings, playgrounds, and apparatus as having laws unto themselves; and away from pupil management and school administration of the mechanical and strictly authoritarian type. The school has become more of a social enterprise. These new educational purposes are reflected in new survey objectives and new survey methods.

Analysis and classification of surveys—Caswell (444, 445, 446) examined a "large number" of reports and set up classifications of surveys as to scope, agency in charge, purposes, and technics used. Eells (450), Sears (472), and Ozanne (466) offer other suggestions. The assumption of these investigators appears to be that the survey is a research method. For higher education the studies of survey reports by Eells (450) and Heston (454) are by far the most thorough and detailed. Heston made a

topical analysis of what surveys had studied and of the recommendations of the surveys. Eells studied 230 printed, 70 mimeographed, and some 300 manuscript survey reports. He classified the reports as to technics used, as to general viewpoint applied, and as to the form of report. It is clear enough from Eells' analysis that the nature of the institution to be surveyed has dictated the research approach, the specific technics to be used, and the special combinations of these.

Bibliographies—Of special value to one desiring to see the school survey in its broader aspects, as an instrument of inquiry aimed at educational betterment, the bibliographical work in the field is important. Following their earlier work Smith and O'Dell (473) brought their bibliography of surveys and of writings on the survey down to December 1937. Eells (450) provided an equally exhaustive bibliography for the field of higher education to 1936.

History and Development of Surveys

A review of the history of the survey movement is given in three more recent reports by Caswell (443), Sears (472), and Judd (457), showing something of the origin and development of the movement, and the nature of the research concepts that dominated the actual work done. Lack of sound research methods available for this kind of work was early brought to light and a strong stimulus was given to research devoted to the development of suitable technics. The historical and comparative methods were applied where possible; the then new technic for revealing retardation was perfected and used; the test movement was brought to bear and given a healthy stimulus; and the interview method was used. Very early also the general purpose of the survey was debated, some hesitating to go beyond the evaluation purpose. In time the more constructive aim dominated and gradually the idea of a survey as a unified study of all parts of a school system, by many separate methods and separate investigations in combination, with a view to improving school practice, brought the survey to its present position.

In the field of higher education the history of surveys has been developed by Heston (454) and Eells (450). Combined, these studies offer an exhaustive review not only of the movement in its general aspects but also of the problems it attacked and the methods applied.

In this general connection, also, a recent volume of the report of the Advisory Committee on Education, prepared by Judd (458), presented a clear picture of the survey as a feature of the research work done by the United States Office of Education. How this research function has been developed from the start in 1867 as one of two major purposes of this Office was traced, and the origin and development of its survey work were made clear. The actual developments within the Office of Education from

local to state and nationwide surveys offer an excellent illustration of the broader social view of the survey as a research instrument.

Methods and Technics Used in Surveys

If one viewed the many individual studies made in any given survey he would not find many entirely new research procedures. It is in the combining of these studies that one finds something different in each survey. To answer any of the questions raised by a survey may call for one or several researches. The researches individually may involve nothing of importance by way of new method, though to have raised the questions and planned the approach may have required profound knowledge and insight and analytical ability. Volumes IV and X of Reeves' University of Chicago survey report (469) offered illustrations of this point. This is to say that survey research is less difficult and less unique in its separate technics than it is in its earlier stages where discovery and definition of problems and an appropriate combination of methods of attack are determined.

Another recent study in the field of higher education stands out both for its originality of approach and its detailed technics of study. The North Central Association Committee on Revision of Standards (464) was concerned with evaluation only—which is but one phase of a complete survey. In seven volumes the report offered a complete explanation of the problems it raised in fifty-seven institutions of higher learning, and gave a full description of the procedure followed and of how the results were used in establishing norms. More use was made of subjective judgment than has been common, but the treatment of such data was in many cases new and unique, as well as convincing to a scientific worker. A brief analysis of this report was presented by Sears (471). It is not too much to say that this study reflected a new viewpoint in evaluation, and in reality a present-day theory of college education applied in accreditation. This latter point was especially revealed by the sections dealing with the care, direction, and encouragement of students. The study produced, also, a complicated but effective instrument of evaluation to be applied to an entire institution. The elements chosen as the indications of excellence were convincing and the statistical treatment of these in numerous cases was unusual. The final tool devised is not new as a technic; it is a score-card type of instrument. Yet, it is quite new as to the elements of which it is made.

In the field of building evaluation higher education surveys may expect to profit from the new standards devised for use with their score-card by Evenden, Strayer, and Engelhardt (451). These standards are not new in the method of their development but are new in the nature of the functions used as the basis against which needs for the various elements were judged.

In the field of city school surveys, Caswell (445) analyzed the technics

used in nine survey reports to determine their treatment of secondary education. He found 34 separate problems had been studied and then for each problem he showed what and how data were assembled for its solution. In a later study (446) Caswell noted seven distinguishable methods by which data were collected, as follows: analysis, score-card and rating scale, standard tests, case study, experiment, interview or questionnaire, and observation. He found thirteen technics for evaluating data or separate features of the school system, as: five uses of comparative procedure (comparison with other units within the system, with comparable outside systems, with neighboring cities, with average practice, and with outstanding practice); equated groups; application of standards; test standards; score-card or rating scale; measuring against research results; judgment of survey staff; expert opinion; and check against trends. Taken separately, the data used, the technics applied, and the procedures followed offer nothing striking as features of research methods. Yet, any but a veteran surveyor would find many new research ideas in the kinds of problems studied and in the data and approaches used in numerous cases.

In the field of physical education Davis (448) studied 207 surveys of all kinds, from which he developed a checklist of methods and technics for use in this field. He then applied this list to 117 city school survey reports, checked it further against other research literature, and developed a rating scale with sets of forms and procedures to guide its use in a survey.

A number of other lesser studies of survey methods could be cited, such as Blauch's study (440), "Curriculum Surveys in Higher Education." From what has been presented, however, it is clear that when one refers to the studies of separate problems he finds little that is new in research method. The new element is not the interview, question schedule, test, or score-card, but the way in which such technics are used in combination that reveals new trends in survey research. One cannot fail to note the difference between survey treatments of curriculum, supervision, library, social program, and personnel problems in recent surveys (Stockton, California, and St. Louis, Missouri, for example), as compared with treatments of a decade or more earlier. In the earlier treatments one finds more bare facts, more counting and adding up, more emphasis on subjectmatter and books, more use of standards; in the later treatments he finds more analysis, more concern with the child and with his personal development. The fitness of curriculum, guidance, and administration of buildings is now judged more by their contribution to the attainment of personal and social aims and less by their conformance to arbitrary standards. A forward look seems to indicate that it is toward clear thinking and careful use of facts rather than something distinctive in research technic that we are to look for development in survey research in the next few years.

CHAPTER XI

Testing: Intelligence, Aptitude, Personality, and Achievement¹

G. M. RUCH and P. T. ORATA

INSPECTION OF SEVERAL HUNDRED TITLES in the field of testing, chiefly between January 1938 and July 1939, indicated that intelligence testing continued to hold first place in number of articles published within the scope of this summary, despite enormous gains in activity in the measurement of aptitude and personality. The bibliography of this chapter, therefore, represents a high degree of both quantitative and qualitative selection in order to place emphasis on new developments in measurement. The omission of much otherwise significant material rests solely on the basis that no outstanding uniqueness of method is involved.

Intelligence

The summaries to 1938 in the *Review of Educational Research* for June 1938 by P. Cattell (501) and Keys (561) comprising, respectively, 68 and 187 titles, need comparatively little supplementation so far as methodology and results are concerned. Developments since that date center chiefly in three areas: (a) further discussion of the 1937 L-M Scales of the Stanford-Binet, (b) renewed controversy over the constancy of the IQ arising chiefly from recent work at the state university of Iowa, and (c) the potentialities of factor analysis in psychological and educational measurement.

The New L-M Stanford-Binet Scales

The two books by Terman and Merrill (619, 620) presenting the L and M scales were the signal for renewed consideration of the Binet method, both for school use and for clinical purposes. Kent (559) presented suggestions for another revision, arguing that the age-scale method is wasteful and not well adapted to clinical practice, particularly when there is "nondiscriminative material at the upper and lower ends of the subject's natural range." R. B. Cattell (502) criticized the intuitive method in test construction in applied psychology, particularly the Binet tests. Vernon's reply (630) to Cattell and other critics of the Binet discussed the merits and limitations of both psychometric and clinical approaches, holding that the Binet embodies both methods. Both Cattell and Vernon listed numerous references. Bernreuter and Carr (487) and Merrill (572) discussed the significance of the IQ's yielded by the new scales; the latter pointed out that the addition of new tests at both the lowest and highest

¹Bibliography for this chapter begins on page 610.

levels of the scale results in a different interpretation of the quotients on old and new scales. For example, the lowest 2 percent of the 1916 sample of 905 cases tested 73 or below, but the lowest 2 percent of the 2,904 cases used in the new scale tested 70 or below. A new table for the interpretation of L-M quotients is presented, with a disclaimer that classification as defective is possible by tests alone. Burt (496) compared the 1937 Binet with the English version of the 1916 scale. He found the new scale more effective in diagnosing the dull and defective, more reliable for showing the relative influences of a general versus other factors, but that the order of difficulty of subtests did not agree with that for English children.

The Constancy of the Intelligence Quotient

The nature-nurture controversy has received new attention as the result of a series of studies from the Iowa Child Welfare Research Station. Skeels (604), basing his conclusions on children tested 12 to 60 months after being placed in foster homes, reported in 1936 that "the mean level of intelligence of these children is higher than would be expected . . . from the educational, socio-economic, and occupational level represented by their true parents." He found zero correlation between true mother's IQ and child's IQ. Later studies by Skeels and others (602, 603, 605) reached the same conclusion. Wellman followed her 1932 report (639) of a steady rise in IQ year by year for children attending the Iowa Pre-school Laboratories with four additional papers (634, 636, 637, 638) advancing similar conclusions. She said: "The extent of upward change that may take place is truly remarkable. We have examples of children entering preschool with average intelligence who, after especially favorable circumstances, have later tested at the 'genius' levels" (634). Stoddard (610, 611, 612) concluded that intelligence level is not fixed, but that a richer environment stimulates genuine mental growth. Skodak (606) and Crissey (509) also suggested that intelligence is much more responsive to environment than has previously been supposed.

This group of Iowa studies has been vigorously challenged by Simpson (600, 601) who claimed that the significance of these studies of the "wandering IQ" is completely obscured by ambiguities and inconsistencies in tabular data, failure to report individual scores year by year, and failure to allow for selective factors in school-leavers. He argued that the rises in IQ mean nothing more than "a survival of the fittest." Wellman (636) replied to Simpson's interpretations, and in another paper (635) she showed a similar, but less marked, increase in Merrill-Palmer IQ's under repeated testing.

Factor Analysis in Psychological Measurement

Cureton and Dunlap (511) summarized the work on the factor theory up to 1938 in the *Review* for June 1938, and Chapter XIII of the current

number, by Holzinger and Harman, brings the literature up to date. The publication of Thurstone's *Primary Mental Abilities* (622) provided the educator with a more concrete picture of the types of test materials that mathematical analysis suggests as useful in the measurement of primary mental traits. It is sufficient at this point to call attention to the fact that the methods of factor analysis and intuitive analysis of psychological abilities present fundamental differences. The time for the production of mental tests based upon factor analysis is at hand; just what similar analysis of educational abilities will yield by way of new achievement tests and curriculum reorganizations is at present challenging but purely speculative. Alexander (478) and Feder (527) applied factor analysis methods to educational tests and Guilford (538) to the production of four new forms of Army Alpha.

Books and Bibliographies

Outstanding aids to the test worker are: Buros' 1939 *Mental Measurements Yearbook* (494) and Hildreth's revised *Bibliography of Mental Tests and Rating Scales* (551). The former provides (usually) two or more critical and independent reviews of tests published since the appearance of Buros' two earlier monographs. An innovation is the inclusion of reviews of books in the field of statistics and measurement. Educational, aptitude, and personality tests are also considered. Hildreth's bibliography is an extension and revision of her 1933 volume, with 4,279 titles classified under 17 headings. These two books provide virtually complete coverage of the field, and together constitute a working reference library of test materials. Revisions appeared of Freeman's *Mental Tests* (529) and Inglis's tables (554) of IQ values, which now provide the extensions demanded by the new Stanford-Binet scales.

Miscellaneous: New Tests, Revisions, Reliability, and Validity

Kuhlmann (564) presented a new intelligence scale resulting from his work with the Binet and Kuhlmann-Anderson tests. Norms were based upon 3,000 cases of ages from three months to adult. In addition to mental ages, scoring methods provided, above age nine, speed and accuracy ratings. The IQ was replaced by the PA (percent of average), as being less variable. Recent revisions are: Otis Quick Scoring (582); Detroit First-Grade Intelligence Test (523); and the Michigan Non-Verbal Series (536). Kerr (560) in England and Miller (573) in America continued to study the value of children's drawings for the measurement of intelligence. Higginson (550) published an objective test of imagination and Carl (499) devised a test for older children and adults in which a hole is filled with blocks of geometric forms; a reliability of .88 based on 1,508 adults and a correlation of about .77 with the Stanford-Binet were reported for the last mentioned test.

Strang (613) and Brill (492) discussed the validity of the Porteus maze test. Williams and Lines (641) evaluated the Ferguson form boards and derived new norms. Evaluations of other tests were reported as follows: Metropolitan Reading Readiness Test and Pintner-Cunningham Primary Mental Test, Grant (535); Kuhlmann-Binet, Arthur (481); Goode-nough drawing test, McCarthy (569); CAVD tests, Pintner and Stanton (585); and the Spearman Visual Perception Test, Arsenian (480). Peatman (584) and Jackson (555) discussed the reliability and meaning of test scores.

Blatz and others (491) presented the growth of the Dionne quintuplets in a series of five monographs. Outstanding conclusions are: The girls show general retardation, especially in language; there are marked and more or less stable personality differences that appear to be environmental in character; and the quintuplets are more retarded in speech than a control twin group.

Watson (632) reviewed the intelligence movement, concluding that there is a great need for more studies of mental development. MacMurray (570) compared gifted and dull-normal children by the Pintner-Paterson and Binet scales. Wilson and Fleming (642) studied the intercorrelation of abilities in the first grade. Vernon (629) suggested that sophistication or test-wiseness may be an important element in test scores.

Aptitudes

Books and Reviews

O'Rourke (581) examined more than 500 studies in aptitude measurement and reviewed 130 vocational aptitude tests in the *Review* for June 1938. Outstanding books have appeared by Bingham (489) and Paterson, Schneider, and Williamson (583). The former discussed the nature of aptitudes and the theory of their measurement. The latter is to be regarded chiefly as a handbook of directions, norms, and data on the validity and reliability of available aptitude tests, particularly those devised at Minnesota.

Aptitude for High School and College

Darley (512), Dickter (515), Langlie (565), and Selover and Porter (599) studied the use of psychological tests in predicting college success. Darley suggested that ability, attitudes, and college adjustment are probably unrelated. Dickter found that the mathematical parts of the CEEB examination predicted success in mathematics, but the verbal elements were of little value. Seagoe compared the predictive values of certain achievement tests with those of special aptitudes in algebra (596) and foreign languages (597). The New Stanford Achievement Test (arithmetic and reading) provided fully as good a basis for prediction as did the intelligence tests or special measures of aptitude in these subjects.

Aptitudes for the Professions and for Selling

Dwyer (521) gave the Strong interest tests to 418 entrants to medical school. Four factors (physicist, journalist, minister, and life insurance salesman) proved of most predictive value. Harris (543) administered five mechanical aptitude tests to 68 dental freshmen; these, combined with intelligence scores, gave a multiple correlation of .67 with dental school work. Stump (616), Stuit (615), and Sandiford and others (594) attempted to find predictive measures of teaching success. Aptitude tests, scholarship ratings, and success in practice teaching all proved to have low predictive value.

Lawe and Raphael (566), Dodge (516), and Bills (488) studied the values of tests for selecting salesmen. The former reported satisfactory results from tests employed at Harrods, Ltd. in London, and suggested the existence of upper and lower critical scores. Dodge listed nine items of the Bernreuter Personality Inventory that differentiate good and poor salesmen. Bills found that the life insurance selling and real-estate selling factors of the Strong interest test are related to success in selling insurance. Candee and Blum (497) devised a new scoring system for the Minnesota Clerical Test.

Mechanical Aptitudes

Drake (517, 518) and Drake and Oleen (519) evaluated various tests for selecting industrial employees and studied the psychological factors necessary to success on the job. Outstanding findings were: a new pin board with a reliability of .92 and a correlation of .59 with foremen's ratings; a new hand-foot coordination test; and 30 percent savings in operation through dual, or two-hand, operation. O'Connor (579, 580) presented further analysis of the Black Cube, Work Sample 167. Candee and Blum (498) gave the O'Connor finger dexterity and tweezer dexterity tests to mediocre and superior workers in a watch factory; the latter proved valid but the former was not except at a lower critical level. Age and experience did not affect the finger dexterity test. Wells (640) published his fourth paper on four O'Connor tests. Hearnshaw (548) described selection tests for inspectors in a paper mill. Burr and Metcalfe (495) revised the norms on the I. E. R. Assembly Test. Babcock and Emerson (482) analyzed the MacQuarrie mechanical ability test, reporting a correlation of .62 with the Binet vocabulary test—a correlation which increased with age as did the intercorrelations of the MacQuarrie subtests.

Personality, Interests, and Attitudes

Books and Reviews

Watson's summary (631) in the June 1938 *Review* of 329 titles published between January 1935 and December 1937 suggested the enormous

activity in the measurement of personality and character. Traxler (623) examined critically the leading tests in the field, listing 183 titles in his bibliography. Important books or monographs appeared by Thorpe (621), Murray (575), Garrett (533), Hartshorne and others (544), and Spencer (609). Thorpe's volume gave a comprehensive survey of the literature from all fields of psychology. Murray presented a detailed study of fifty men of college age over a two and one-half year period. Garrett used Thurstone's centroid method of factor analysis as a first step in defining and measuring personality traits. Hartshorne and others studied the intellectual, social, moral, and physical growth of 1,200 boys. Spencer's volume presented the personality conflicts of high-school students as revealed by a paper-and-pencil questionnaire.

Experimental Studies of Personality Tests

The Bernreuter Personality Inventory continued to receive critical attention. Farnsworth (526) retested 319 college students with the Bernreuter inventory at intervals of one, two, and three years. Responses proved relatively stable with time, as were intercorrelations. Jarvie and Johns (556) concluded that the Bernreuter inventory offers little aid in educational counseling. Nemzek (578) found the inventory of little value in predicting academic success as measured by teachers' marks. Hayes (547) decided that college women with several older siblings tended to be more neurotic and less self-sufficient and dominant, a finding previously reported by Stagner and Katsoff. Bennett (486) further simplified the Flanagan method of scoring the Bernreuter inventory.

Research on the Rorschach Ink Blot Test took mainly the direction of standardization of this clinical method. Troup (624) applied this test to twenty pairs of identical twins; no marked resemblances in temperament were found. Hertz (549) and Soares (617) attempted to objectify scoring and provide further norms. Fosberg (528) reported that the reactions were stable under retesting, even with changed directions. Rorschach data from many investigators were summarized by Davidson and Klopfer (513).

Interests and Attitudes

Strong (614) published a new edition of his Vocational Interest Blank for Men. Kopas (562) developed a "point-tally" method for scoring the Strong blank. Using the Strong scores as a criterion, Estes and Horn (525) constructed two scales that would differentiate between interests in mechanical and in electrical engineering. Carter and Jones (500) found the Strong scores to be closely related to high-school students' vocational choices. Garrison (534) and Cleeton (505) developed new interest inventories. Davies (514) cautioned test workers against giving interests an "all-determinative" role in vocational choices.

In an extensive study of 3,758 students in four state universities and fourteen church colleges, Nelson (577) gave the Lentz C-R Opinionaire to determine the prevalence of radicalism. The mean scores tended toward conservatism; few radicals were found; seniors were less conservative than freshmen; women were more conservative than men; and small differences were found from school to school. Corey and Beery (507) concluded that liking for school subjects is closely related to liking for the instructor.

Ratings

Few, if any, unique contributions in the use of ratings came to the attention of the reviewers within the period covered here. One extensive study was that of Eells (522) who studied the best liked and least liked aspects of 200 secondary schools, securing 24,000 returns. Scales were formulated that grouped these aspects under such headings as school staff, curriculum, pupil activity program, and guidance. (For other studies on ratings, see references 409, 493, 504, 574.)

Miscellaneous

Bell (485) published an adult form of his adjustment inventory that includes: (a) home adjustment, (b) health adjustment, (c) social adjustment, (d) emotional adjustment, and (e) occupational adjustment. Experimental studies of the following personality measures have been made, as follows: Willoughby (524), Baxter (484), Stanford M-F test (592), Woodworth-Cady and Baker "Telling What I Do" test (643), and the Loofbourow-Keys Personal Index (591).

Achievement

Books, Reviews, and Monographs

In the *Review* for December 1938, which summarized more than four hundred studies of educational tests and their uses, Scates (595) emphasized the changing conception of measurement, shown particularly in the work of the Eight Year Evaluation Study.

McCall's *Measurement* (568), a revision of his early text, was conspicuous for its shift toward the aims of the progressive education movement. Smith (607) devoted 182 pages to a critical examination of concepts of testing, a volume that has already proved very stimulating to those interested in the fundamentals of measurement. South (608) compiled a glossary of terms used in measurement and guidance. Ruch and Segel (593) prepared a handbook for counselors, on the use of the individual inventory in guidance. Segel (598) also summarized the cumulative record systems of 177 school systems.

Test Technics

Omitting for the present the Evaluation Study, several papers on test technics should be mentioned. May (571) wrote a very penetrating discussion of the logic of measurement. Kuder and Richardson (563) and Remmers and Whisler (590) considered critically the concept of the reliability coefficient, particularly its limitations. Kelley (558) showed that, under defined conditions, "upper and lower groups consisting of 27 percent from the extremes of the criterion score distribution are optimal for the study (of the validity) of test items." Lev (567) used the method of analysis of variance to evaluate items and give them their proper weights. Guilford (539, 540) applied Fechner's law to the scaling of test items, holding that the easiness of an item is proportional to the logarithm of the magnitude of the stimulus. Dunlap (520) found that two-response tests requiring underlining were more open to scoring errors than certain other response forms.

Evaluation versus Measurement

Although logically a part of the discussion of achievement testing, this concluding section of the present summary is set apart for the sake of emphasis. It is a greatly condensed treatment of a review involving 129 titles. Space limitations have often necessitated the omission of authors' names in the citations.

The Philosophy and Function of Evaluation

The change in terminology from "testing" and "measurement" to "appraisal" and "evaluation" was regarded by Hoscic (552) as a significant development in education. Tyler (627, 628) held that the emphasis is not on the relative merits of tests, but on the extent to which evaluation instruments promote as well as measure important outcomes of instruction. According to this point of view the functions of evaluation are no different from those of the school as a whole, namely, to help provide more intelligent guidance of teaching and learning, to develop more effective curriculums and educative experience, to secure more intelligent and effective cooperation with parents and community, and to provide an adequate and objective basis for measuring, recording, and reporting progress that facilitates the desired learning (576, 618).

The hypotheses of evaluation—According to Wrightstone (646) the new point of view in evaluation is based on a number of hypotheses radically different from those of Thorndike. Curriculum change and evaluation are coordinate aspects of the educative process; a program of evaluation should be comprehensive; and present instruments are inadequate for many of the major objectives of education. Hence there is need for a variety of new means and technics for gathering evidence. The measures should

correspond to the functional units of pupil behavior in actual curriculum situations; reliable and valid objective instruments of measurement are restricted to an appraisal of limited aspects of pupil behavior; and measures of functional behavior can best be developed by teachers working in cooperation with test technicians.

The Nature of Desired Achievement in the School Subjects

In view of these newer objectives of education the school subjects are expected to show correspondingly new kinds of results. Art should develop initiative, interest, judgment, and cooperation (537); the physical sciences, the ability to use experimental methods in gathering, organizing, and interpreting scientific data and in applying scientific facts and principles (483, 530, 531, 532, 541, 627); English literature, the reading of literature understandingly, a broader understanding of life, greater sensitivity to social problems, and increasing intelligence with regard to human motives and purposes (557); French and Latin, sufficient command of French and Latin vocabularies for simple reading and speaking (647, 650); home economics, better health, and a happier home life for all members of the family (503, 553, 586, 587); mathematics, thoroughness and precision in thought and action, disposition to question the validity of assumptions, expressed or implied, and sensitivity to the logic of arguments (545, 546); nursing, proper attitudes toward patients, other nurses, and physicians, and a wide range of interest not only in nursing but also in other and related fields, as well as the proper habits and skills in the performance of nursing activities (510, 626); social studies, sensitivity to and disposition and ability to deal with social problems in an intelligent manner, interest in international affairs and human welfare, and attitudes favorable to social improvement (479, 576, 589, 648, 651, 652); health and physical education, physical fitness, lively curiosity, self-confidence, and quickness and decisiveness of movement (508, 649).

Constructing Newer Achievement Examinations

The steps in constructing achievement examinations, according to the foregoing point of view, are likewise different from the well-established technics of objective test construction. They may be summarized as follows: (a) specifying the objectives of the school program as a whole; (b) restating, if necessary, each of these objectives in the light of the nature, characteristics, and requirements of the course, field, unit, or area in the school program that is to be evaluated; (c) defining the types of behavior that normally show whether or not and to what extent the objectives are being realized; (d) selecting test situations that will evoke the types of student behavior patterns consistent with the objectives; and (e) trying out these test situations with a view to improving their validity

and reliability and, at the same time, working toward making them more practicable (626, 627).

Evaluation instruments—A number of new instruments have been constructed both for appraising the school as a whole (542, 589, 644, 645, 646, 651) and specific segments or areas of it. Of the latter type are those that bear the following titles: A Scale of Beliefs, Interpretation of Data, Familiarity with Sources of Data, Application of Principles of Thinking (several subject fields), Interest Index, Problems Relating to Proof in Mathematics, Literary Information Test (both English and American literature), Questionnaire on Reading Interests and Reading Outcomes, Critical Mindedness in the Reading of Fiction, Judging Effectiveness of Written Composition, Questionnaire on Voluntary Reading, Descriptive Test Profile, Evaluation of Reading, and a Checklist of Magazines (588).

Developing a comprehensive program of evaluation—Tyler (576, 621) suggested ways and means of developing a program of evaluation that is both comprehensive and practicable "by making the appraisal an integral part of the learning process, by encouraging the pupil to make his own evaluation, by utilizing situations for evaluation which throw light upon the pupil's development at those points where the collection of direct evidence is highly impracticable."

Needed research in evaluation—In order to develop a comprehensive program of evaluation, research is needed "in discovering types of behavior which ought to be appraised, in devising means for appraising each important type of behavior, in refining appraisal instruments, in interpreting test results, and in follow-up studies regarding the permanence of learning" (625). Research in interest evaluation was also stressed by Weedon (633).

Critical Evaluation of Evaluation

Curiously enough, "evaluation" has been criticized on the same grounds as those on which it has criticized "measurement." The following represent some of the negative comments on the work of Tyler, Wrightstone, and others. The technics may be valid, but "not adequate"; "failure to supply clearcut data regarding the practices evaluated seriously weakens the scientific validity of the study"; "the study is subject to the usual lack of reliability, validity, and adequate sampling"; and "statistical significance alone does not prove educational significance" (494:271-72).

CHAPTER XII

Rating Scales, Score-Cards, and Checklists¹

LEO J. BRUECKNER

THE PURPOSE of rating scales, score cards, and checklists in educational research is to provide criteria useful in describing and evaluating some phase or element in the total learning situation. The following sections discuss a number of areas in which these instruments have been applied, including the appraisal of educational institutions and programs, descriptions of instructional practices, technics for evaluating curriculums and courses of study, methods of rating the staff and pupils, procedures for appraising materials of instruction, and methods of rating schoolbuildings. The materials reviewed are drawn largely from studies published within the last five years. References to summaries of earlier research are included when available.

Means of Appraising Educational Institutions and Programs

The past decade has witnessed the development of a series of checklists for describing and evaluating the elements of state programs of education; the characteristics of elementary schools, secondary schools, and colleges; and the provisions made by states for handicapped children. The first of these to appear was a comprehensive checklist for a self-survey of state school systems (677) published in 1930. It included checklists for studying the provisions made for the child and his welfare, the status of the teaching profession, state school finance, material equipment, and administration and control. In 1932 Mort (673) published a scale for rating elementary-school organization. Subsequently in 1937 Mort and Cornell (672) published a carefully constructed guide to be used by school systems to measure the extent to which local practices, related to curriculum, instruction, and administration, were in accord with progressive practices found in the best school systems. The items in this checklist were selected on the basis that they clearly differentiated between practices of schools regarded as progressive and conservative. Provision was made in the checklist for giving evidence to support the evaluation made.

The Cooperative Study of Secondary Schools in 1938 published a set of evaluative criteria in the form of comprehensive checklists for evaluating secondary schools (656, 657). These materials were the product of a group of specialists in secondary education. The blanks were tried out in a wide variety of schools and were found to be suggestive and stimulating. Their greatest value appears to grow out of their use for self-survey purposes.

¹Bibliography for this chapter begins on page 617.

Probably the most pretentious undertaking in the field of the development of checklists for evaluating institutions was the work of the Commission on Higher Institutions of the North Central Association of Colleges and Secondary Schools (694). This commission undertook to study the validity of standards being used for determining admission to the Association, by securing quantitative information from a selected group of institutions concerning many phases of their programs and then determining the relationship between these data and a ranking of the institutions on the basis of judged general merit. Profiles for each institution were prepared based on the items studied. The general conclusion was reached that there was little merit in the prevailing standards. It was also recommended that specific standards should not be set up as a basis for admission of institutions but that the Association encourage each institution to make a continuous study of its own program and that from time to time surveys be made of various standards to discover what the trends are. This investigation afforded an excellent illustration of the type of research that is needed to validate checklists and score cards of all kinds. Another example of this kind of study was the report by Crayton (658) of a series of standards in the form of checklists for evaluating the adequacy of the provisions made by a state for the education of various kinds of handicapped children. Crayton's checklist grew out of a survey and evaluation of best practices and legal provisions from all parts of the country.

Descriptions of Instructional Practices

The application of scientific procedures by supervisors has included the extensive use of rating scales and detailed checklists of all kinds to describe instructional practices. For example, Gray and Whipple (663) prepared a description of five levels of the teaching of reading which serve as a scale for rating the quality of the reading program. Feany (661), Brueckner (674:32-50), Otto (679), and others (653) reported the results of the extensive use of checklists to gather information about teaching practices in such areas as social studies, arithmetic, and general education. Peik (680) published checklists to be used in the analysis and evaluation of recitations and units of work. In *The Activity Movement* (678) there was published a checklist for securing the judgments of persons concerning their points of view on a number of moot issues in education. Several comprehensive discussions of these kinds of procedures are available to which the reader is referred for further information (653, 676).

Technics for Evaluating Curriculums and Courses of Study

Several checklists have been prepared which provide excellent bases for evaluating curriculums and courses of study. The earliest of these by Stratemeyer and Bruner (685) has been widely applied. Bruner (655)

recently published a revision of this checklist. Harap (665) made a survey of new courses of study on the basis of another checklist of items. Leary (670) also published a similar checklist. The value of these materials lies in the detailed analysis they made of items that should be considered by any committee at work on the preparation of a curriculum or course of study.

Methods of Rating Personnel

Several excellent discussions of the use of rating scales for appraising personnel have been published to which the reader is referred for information about the history of the movement (654, 682, 691). Towner (686) reported the results of an analysis of items included in rating scales for elementary-school principals. Smith (684) made an analysis of rating sheets used for rating student teachers. The inadequacy of most of the available teacher-rating scales has been well demonstrated by Sandiford (682) and a study edited by Walker (688). In both of these studies it was demonstrated that there is a very low correlation between currently accepted measures of teaching ability and ratings of teachers. The need for extensive research in the field of teacher rating is very great.

A number of significant studies have been made of the use of rating scales and checklists in appraising the characteristics of the learner. One of the most important of these is that of Van Alstyne (687) who developed a scale for rating behavior of children in classrooms, using dependable statistical procedures. Pistor (681) developed a checklist for appraising pupil behavior in progressive schools. Eckert and Marshall (659) reported the results of the application of an inventory in the form of a checklist of the characteristics of pupils at the time they left the schools of New York. This information was used by the Regents' Inquiry as one of the bases of evaluating the program of secondary education in that state. Zyve (695) and Flory (662) made significant recommendations of the kinds of information that should be secured as a means of studying the changes that take place in the learner.

Appraising Materials of Instruction

Rating scales and score cards of many kinds are used in evaluating textbooks and other kinds of materials of instruction. Whipple (693) reported the results of a study of the kinds of items included in a large number of rating scales used in many school systems in selecting textbooks. Her summary of items should be very helpful in preparing more adequate checklists of this kind. Gray and Leary (664) studied the validity of a large number of items that might be considered in determining the readability of a book. A number of checklists for rating textbooks in English (683), arithmetic (689), reading (690), and other subjects have also

appeared. The significance of these materials is the evidence that increasingly helpful efforts are being made to apply objective statistical technics in the selection of textbooks and other instructional materials. A series of checklists for studying the selection and use of a wide variety of materials of instruction was presented in the yearbook, *Materials of Instruction* (675). Wesley (692) published a checklist to be used as the basis of making a community survey.

Rating School Buildings

For many years score cards for rating school buildings have been used in school surveys. Three numbers of the *Review of Educational Research* have been devoted to the issues involved (666, 667, 668). The reader is referred to these numbers for detailed information. Two relatively new score cards include one by Engelhardt (660) for the elementary-school buildings and a general set of standards by Holy and Arnold (669). Special attention on the part of the reader is invited to the important study by Long (671) about the kinds of physical facilities teachers desire for carrying on activity programs. Long's study suggested a procedure that may be used more widely to establish the validity of scales for rating buildings and equipment. It is unfortunately true that at present building score cards are largely the expressions of judgments of various individuals, unsupported by any competent evidence that the specifications which are set up are in fact adapted to the carrying on of effective educational programs.

CHAPTER XIII

Factor Analysis¹

KARL J. HOLZINGER and HARRY H. HARMAN

SINCE FACTOR ANALYSIS is a relatively new subject and only a very brief review of its literature (705) has appeared in previous issues of the *Review of Educational Research*, it seems desirable to start at the beginning. Only the most significant articles can be considered in the allotted space. Many of the early papers which contributed to methodology, but whose proposals have since been replaced by simpler and more efficient procedures, have been omitted here. Greatest emphasis has been placed on the research of the last four years, but even for this period about half of the published articles had to be omitted.

Two-Factor Theory

The field of statistics known as factor analysis was founded by Spearman (746) in 1904 when he argued that "*all branches of intellectual activity have in common one fundamental function (or group of functions), whereas the remaining or specific elements of the activity seem in every case to be wholly different from that in all the others.*" This paper was the first in a series which led to the formulation of the famous Theory of Two Factors and which culminated with his *Abilities of Man* (745) in 1927. The first major test in practice of Spearman's theory was undertaken by Burt (699) in 1909 when he studied the intercorrelations for two groups of Oxford schoolboys on twelve tests.

In an important study, Brown and Stephenson (698) verified the Theory of Two Factors on an adequate statistical basis. This research was partially in answer to a critical article by Pearson and Moul (741) in which they suggested that "some 12 to 15 abilities . . . the abilities being settled by psychologists a priori to avoid 'overlaps,' are essential to a satisfactory test, the observations to be made on a homogeneous population of several hundreds." In another application of the Two-Factor Theory, Webb (768) found a general factor on the side of character, closely related to "persistence of motives," in addition to the general intellectual factor.

The statistical adequacy of the Two-Factor Theory is furnished by the vanishing of all "tetrads" (745). Sampling errors for individual and average tetrads from a set of correlations were developed by Spearman and Holzinger (748). A number of critical papers relating to the validity of the tetrad criterion include those of Emmett (711), Heywood (717), Irwin (727, 728), Piaggio (742), and Wilson (769).

¹ Bibliography for this chapter begins on page 619.

In an important paper Garnett (713) in 1919 reviewed the literature on the Two-Factor Theory. He also presented the theory in a rigorous mathematical form including a geometric approach which has since been followed by such analysts as Thurstone (765).

Bifactor Theories

In more recent years, when psychologists started to use larger and more varied batteries of tests, they found that the tetrad criterion was generally not satisfied. Since this finding implies that a single general factor is not sufficient to account for the intercorrelations, a more elaborate theory was required. The bifactor theory as developed by Holzinger (719) postulated a general factor, a number of group factors identified with the mutually exclusive subsets of tests, and factors specific to each test. An elementary exposition of the bifactor method was presented in *Student Manual of Factor Analysis* (722). A number of applications of this method were reported under the sponsorship of the Unitary Traits Committee, of which E. L. Thorndike was chairman (719). A study indicating the stability of a bifactor solution was reported by Holzinger and Swineford (723).

A set of standards for judging various factorial analyses was presented by Holzinger and Harman (720). In this paper they also showed the relationships between the bifactor solution and several of the multiple-factor types. These authors (718) made a practical comparison between the bifactor analysis and Thurstone's earlier verbal description of an analysis which was later presented in his *Primary Mental Abilities* (764).

A simple nonmathematical method of factor analysis which was presented by Tryon (766) may be considered as essentially of the bifactor type. He grouped the tests into clusters and obtained final correlation profiles which reveal the essential nature of the underlying factors.

Multiple-Factor Theories

The earliest important contribution to the theory of multiple factor analysis was provided by Kelley in *Cross-Roads in the Mind of Men* (729). Using the tetrad criterion as a foundation, he developed more elaborate conditions for the existence of varying numbers of common and specific factors. The ensuing analyses involved complex overlapping of these factors.

In a later development of multiple-factor analysis, Thurstone (762, 765) provided a method involving two stages. First a preliminary solution is obtained and then this is rotated to a form which he regards as psychologically meaningful. The standards postulated for the final form of solution preclude the existence of a general factor. Thus the multiple-factor and bifactor solutions are essentially different in form, but like all

factor solutions they may be converted from one to the other by suitable transformations (720). Since *The Vectors of Mind* (765), Thurstone has contributed a number of modifications to his method (761, 763). A simple variation of method is also furnished by Woodrow and Wilson (770).

Two of the more important applications of multiple-factor analysis are those of Thurstone (763) and Mosier (740). Thurstone identified several "primary" mental abilities, while Mosier made an analysis of certain neurotic symptoms. Roff (743) and Dwyer (709) contributed papers dealing with the relation of multiple-factor analysis to aspects of classical statistical procedures. Horst (724) developed a method for describing a set of variables in terms of common factors such that all factors are determined simultaneously.

Principal Component Theories

Another variation of methods involving many common factors was suggested by Kelley and developed by Hotelling (725, 726) as the theory of principal components. These components are general factors, the first of which enters positively into all the variables, while the remaining ones have both positive and negative weights. Later Kelley (730) furnished a different statistical procedure but "the outcome is identical with that given by Hotelling's method of analysis." Lev (736), however, pointed out that the results of the two methods are in agreement only when the variances of all variables are the same.

Several papers have appeared showing relationships between multiple-factor and component analyses. Girshick (714) re-examined the statistical bases of the theory of principal components and answered two major criticisms raised by Thurstone (765). Kellogg (732) showed that by suitable modification of Thurstone's procedure the resulting technic would be identical with Hotelling's. He also argued for the use of communalities in the diagonal elements of the correlation matrix with any method of analysis.

Kelley and Krey (731) applied the method of principal components to the study of character traits in the field of social science. By a somewhat different type of analysis Burt (701) obtained several emotional factors of the component form. McCloy, Matheny, and Knott (738) obtained solutions of the multiple-factor and component form, and compared them. Thomson (757) showed that Hotelling's method can be modified slightly to give Spearman's solution for the case of a single general factor.

General Statistical Contributions

In contrast to the use of correlations between tests, which have ordinarily been employed as the basic data in factor analysis, Stephenson (749, 750) argued for the use of the correlations between persons. For example, in

his study of typology direct factors among persons instead of the personality traits were obtained (751).

Thomson (756, 759) proposed a Sampling Theory of ability in which he regarded a number of factors as being a sample of all those employed by an individual in carrying out various mental tasks. Dodd (707) made a critical analysis of the Sampling Theory and compared it with Spearman's Two-Factor Theory. Mackie (739) furnished the probable value of the tetrad difference on the Sampling Theory.

In factor analysis, linear descriptions of the tests in terms of the factors are ordinarily obtained. To determine an individual's factors, then, an estimate of these in terms of the tests is necessary. Methods for estimation by means of regression equations have been presented by Thomson (760), Harman (716), and Ledermann (733). Bartlett (696) proposed an alternate method based upon the minimizing of specific factors. Papers by Dwyer (710) and Harman (715) were written on the subject of introducing solutions for additional tests after the factorization had been completed.

A theoretical presentation of the criteria for determining the rank of the reduced correlational matrix was given by Ledermann (734). Another paper on this topic was presented by Young (771), who obtained an index of clustering to determine the number of common factors. Burt (703) has pointed out that "with a sufficient number of self-multiplications, any . . . table of correlation or covariances *can be reduced as closely as we wish to a matrix of rank one*, i. e., to a Spearman hierarchy."

Another topic, which is chiefly of theoretical importance, is concerned with the conditions determining the minimum number of tests in which a factor must be present. Such boundary conditions have been developed by Thompson (752, 753), and the probable errors of some of them have been obtained by Black (697). Ledermann (735) has given rigorous proofs of certain theorems involved in the boundary conditions which have been conveniently formulated by Thomson (754).

In a cleverly written, stimulating paper Cureton (706) calls attention to some of the underlying assumptions made by the various approaches to factor analysis.

CHAPTER XIV

Index Numbers and Related Composites¹

DOUGLAS E. SCATES

Why Index Numbers?

EDUCATORS ARE CONCERNED with index numbers because (a) they are useful in reflecting trends in the financial aspects of public education; (b) they are useful in evaluating educational proficiency; and (c) they are available in abundance for measuring economic factors which affect the support of education, and which, when properly interpreted, should have some significance for the curriculum.

An index number is a statistical technic for representing change in a variable when this change may be regarded as (or may be reflected in) the sum of changes in a number of more elemental variables. The elemental variables (referred to as criteria in evaluative index numbers) may be independent or correlated; may be homogeneous or heterogeneous (individually and as a group); may have weights which are constant or variable for each element; and are usually but a sampling of the total number of elementary variables known to compose or affect the general trait. Index numbers had their origin in economics with their purpose to reflect average changes in price, and they are still popularly thought of in that connection. They have been used in educational research to show changes in composite costs; to indicate weighted changes in quantities of cases; and to represent variations in quality. They may be employed to represent a composite change from time to time, from place to place, or from one set of conditions to another, among any group of observed variables. Their greatest service is in the measurement of a general character which is not susceptible of direct measurement, though they are not limited to this purpose.

The technic is flexible, having the advantages over a multiple regression technic of not requiring a criterion (dependent variable), of accommodating a large number of variables without undue labor, of permitting variable weights for each factor, and of requiring a theoretical minimum of only one (or two) cases, in the ordinary sense. On the other hand, these points are not always clear advantages. The fact that there is no criterion variable employed for index numbers necessitates that the weights and factors be selected with varying degrees of arbitrariness. It is possible that factor analysis may be available to reduce this arbitrariness in certain fields of application.

What Constitutes an Index Number?

The typical index number has certain rather definite characteristics: it is (a) a summation or average (b) of many elements, (c) these being a

¹ Bibliography for this chapter begins on page 622.

sample of a larger universe of elements, (d) each of the elements receiving a weight (e) which varies from observation to observation, (f) the values at any observation being expressed as a percent of the value for some observation point selected as the base, (g) with various types of formula rectification for bias. In practice we find variations which depart from this typical pattern by all possible degrees; each one of the characteristics individually is lacking in some one or another type of value which is called an "index" or "index number," and usually several of the characters are lacking. The most typical structure, as above described, degenerates commonly in one of four directions: (a) the value represents only a single trait, instead of a composite of traits, expressed as a ratio to a constant base; (b) the value represents a composite, but is not expressed as a ratio; (c) constant rather than variable weights are used; (d) the various traits or elements are not combined but are left separate. We shall recognize here types (a), (b), and (c) for the purpose of the present discussion; type (d) represents only the raw material for an index. While economic statisticians customarily take for granted the relative or ratio aspect of index numbers, educational and psychological statisticians are primarily interested in the fact that they are composites, and so are concerned with type (b); the detail of expressing these as ratios does not seem to be important.

As for definitions, an extensive set can be found in the Kurtz-Edgerton *Statistical Dictionary* (818) which was just published. This volume defined nearly 100 index number terms, answering a multitude of questions which arise during reading and conversing about index numbers. Almost anyone can review with profit the definitions of even basic concepts, such as time reversal test, factor reversal test, circular test, link relative index number, chain index number, aggregative index number, splicing, and rectification. The less well-known terms also afford interest. Other definitions and descriptions will be found scattered through the literature; see especially (777).

Previous General Treatises

Fisher's book (800) is still the principal work, although many new points are being emphasized in current literature. His book included two bibliographies, of 20 and 39 references (p. 519-23), which open up the earlier literature. Good, Barr, and Scates (808:440-54) gave the most comprehensive discussion in educational sources, treating the common economic indexes, such as wholesale prices, retail prices, cost of living, and various business indicators; index numbers for school costs—supplies, building material, bond rates, teachers' salaries, teachers' costs of living, and general increases in school expenditures, and also the evaluative index numbers for rating school systems. Monroe and Engelhart (828) referred to about a dozen index numbers in education. Scates (852) discussed the general nature and applicability of index numbers for educational problems, citing

examples. These four treatises cover the pertinent literature before 1936 and should be consulted for basic material and outstanding examples of index number series. With but few exceptions, the works cited in these treatises will not be repeated here.

Ability, Effort, and Need in the Support of Education

Studies of major import have been directed toward the measurement of the ability to support schools, the effort that is being put forth to support them, and the residual need in the support of public education, by states and other political units. In most cases these studies utilize some form of index number. Mort has been active in producing, directing, and stimulating studies in this area; we should mention his own studies on state support, of 1924, 1926, and 1933 (832, 834, 835), and on federal support, of 1934 and 1936 (831, 833), in addition to several studies of individual states. Some of this work rests on a regression equation; other parts embody characteristic index number technics. The National Education Association's Research Division in 1926 (837), and in 1937 Norton and Norton (845), reported indexes of financial ability, financial provisions, and adequacy of educational program for the forty-eight states. The 1926 report is regarded as "the pioneer study in the area of the relative ability of the states to support education." Newcomer (843), in 1935 and Chism (781), in 1936 prepared indexes of the ability of individual states to finance education.

The Research Division of the National Education Association utilized the findings of Newcomer and Chism, in addition to other data, in a study of the needs and the effort being put forth by the different states to meet their needs (838). Chapter II of that report reviewed previous research on indexing the efforts of local communities and states to support education, as well as research on the adequacy of educational programs in communities and states. A bibliography was given at the end of the bulletin and in footnotes. Studies of ability of local districts were made by Cornell (785) and by Overn and Knapp (846). Most of these studies have been covered in some detail in the *Review* for April 1938.

While a clearcut form of index number is not in evidence in some of these studies the function of the raw data employed is a weighted summation of elementary variables, frequently referred to a temporal or geographical base, and all the studies could be cast into the form of an index number formula. They are therefore important examples of the type of measurement for which this technic is adapted.

Representing and Analyzing Increasing Costs

In ascertaining the factors which have given rise to increasing school costs from 1914 to 1930 the Research Division of the National Education Association (842) prepared detailed index numbers for eleven different

classes of school expenditures and then combined these to form a general index number of public school costs. This index number increased from 100 to 171 in the sixteen-year period; the reciprocal of this series was used to give the purchasing power of the school dollar, which declined from 100 to 59.

As a second factor in the increasing cost the Research Division estimated the increase in educational load. Account was taken of the increasing proportion of high-school pupils by converting them into equivalent elementary-school pupils on the basis of relative cost. This procedure is the logical equivalent of employing a quantity index number. Scates and Baetz (854) calculated a quantity index number for the public schools of Cincinnati and derived from it a unit cost trend unaffected by the changing composition of the school population. This use of quantity index numbers represents a technic for the elimination of undesired factors. So far it has not been exploited.

A number of cost-of-living indexes for teachers were prepared before 1936 and are reviewed in the sources mentioned at the outset (808:449). Most of these were summarized in a National Education Association *Research Bulletin* (841). One of them was examined experimentally in a study of the effect of weights (851). The series of index numbers by Clark and others on school bonds, school supplies, and schoolhouse construction were also reviewed previously (808).

Index Numbers for Rating State School Systems

Another large purpose for which index numbers are used in education is the evaluation of schools and school systems. Perhaps the most pretentious of these indexes have been the ratings of state school systems, which began with Ayres' work in 1912. The earlier ones have been covered in sources previously mentioned (808:441-42). A National Education Association study (839) should be cited again because of its excellent review of earlier works; a later bulletin (838) mentioned a number of the studies also. The National Education Association (839) advanced five criteria for rating states, but did not combine them; Scates and Fauntleroy (851) tried several sets of weights on these series, resulting in an index number series for the states based on equal weights and one based on natural weights, in addition to other series of less immediate interest. These data represented approximately the year 1930. Scates also recalculated the index number of Schrammel and Sonnenberg because it was based on provisional data and contained errors; this revision (853) brought the index number data for the states up to 1934. Furney (805, 806) used basic data for 1936, offering two separate index numbers—the first consisting of five non-financial factors and the second consisting of five financial factors. He found a correlation of .82 between his two index number series. (Ayres, 1920, reported a correlation of .78 between his financial and nonfinancial

factors.) Furney analyzed his index numbers according to the density of population; Phillips also did this with his 1930 index. Jobe (813), using five criteria, computed index numbers for ranking the states for each of the years 1926, 1928, 1930, 1932, 1934, and 1936. He made special comparisons among sixteen southern states. For 1936 he included two other index numbers, one based on actual (raw) data and one on six criteria.

The correlation of .8 between financial and nonfinancial criteria is significant in the light of criticism sometimes brought against the index numbers, namely, that they are too heavily weighted with financial items which do not in themselves represent merit. The correlation found suggests that the financial items are not being given undue weight; for the most part they agree with the nonfinancial items, and for the extent to which they differ from the nonfinancial items there is more reason for assuming that the major portion of this difference is in the direction of merit (representing phases of merit not reflected in the nonfinancial factors) than there is for assuming that the major portion will be in the opposite direction.

The Rating of Selected Groups of Schools

The Cooperative Study of Secondary School Standards, sponsored by six regional accrediting associations of colleges and secondary schools, developed a series of rating procedures. The total score on the nine summary evaluative criteria and the grand total score on the seven different kinds of measurement both carried the structure of an evaluative index number (784, 797). The Committee gave large attention to the selection of its criteria and has recognized the importance of the effect of these criteria upon the growth efforts of the schools, as well as their service in measurement. By comparison, the criteria employed in the studies which have produced index numbers of state school systems appeared superficial and mechanical; it should be said however that the nationwide evaluations included elementary schools as well as high schools, and they had to depend upon official figures which were available for all the states. The accrediting associations were concerned only with schools coming under their jurisdiction, from which they secured the desired facts. The work of this Committee may be traced through references given in the *Education Index* under the name of the committee.

The North Central Association of Secondary Schools and Colleges has done a similar piece of work for the purpose of determining accreditation of colleges and universities. The study was published in seven volumes which are reviewed briefly by Sears (857). The report evidenced unusual care and extensive study in the selection of the criteria. The percentile ratings which were given on eighty-one separate items, grouped into eleven major divisions, could be added together, the total having the structure of an equally weighted index number. It was evident, however, that the Committee was not primarily concerned with a total score but was interested

in the profile of ratings and desired to judge the entire pattern as a pattern and not as a mechanical sum of its elements. Further, each profile pattern was to be judged in the light of the declared objectives of each institution. To those who are interested primarily in quantitative technics this conclusion offered a challenge. Granting that the profile will always serve certain ends which a total cannot, we may raise a question as to whether the final determination of acceptability could not be accomplished through the application of the index number technic without doing violence to the purposes of the Committee. Such an index number would have to utilize selective groupings of traits and variable weights (perhaps weights which varied with different ratings on a given trait)—the groupings and the weights to be ascertained from an analysis of the discussions and conclusions of judges when at work determining accreditation, so that the values and the degrees of compensation could be determined. This problem has not yet been worked out in the field of rating, but its delicacy and complexity are not beyond the possibility of methodological treatment. The underlying problem is essentially the same as that of the cost-of-living index. In our evaluative index numbers, and in rating scales, we have remained too contentedly in the primitive stage of constant weights.

Foster (801) produced a composite rating of graduate schools based on twenty-eight criteria. Eells (796) objected to the natural weighting used by Foster and recalculated the index, giving equal weight to each of the twenty-eight traits. The change of weighting changed the position of several institutions. An index number consisting of eight elements for rating both private and public higher institutions in states was prepared by Chamberlain and Meece (780). Hoffman (811) proposed one for secondary schools.

Other Educational Applications

Dwyer (794) sought a measure of college teaching load which would combine various aspects of load and would be based on objective data. He found that three elements, namely, the number of different credit hours taught, the number of teaching hours, and the total enrolment, equally weighted, gave nearly the same results as an index number composed of sixteen elements. The figures shown in the report were, however, averages for departments, or other sizable groups; the finding might not hold for individual instructors. Dwyer's conclusions agreed closely with the recommendations of Reeves and Russell (849) of ten years ago. The formula of Douglass (793) on teaching load in secondary schools becomes an index number when the traits are expressed in appropriate units and properly subdivided. Boardman (776) reported on the use of an expanded form of Douglass' formula. Overn (847) calculated a "single-factor" type of index for teacher demand for the state of Minnesota. The National Education Association (840) calculated a group-to-group index number of educational salaries for 1938-39.

United States Bureau of Labor Statistics Indexes

Several index number series of the Bureau of Labor Statistics—which are probably the most widely used basic index numbers in the country—have undergone revision during the past four years. Weights for the cost-of-living index were heretofore based on “the spending of families of wage-earners and lower-salaried workers, as shown by the Bureau’s study of the expenditures of 12,096 families in 1917-19” (see the *Journal of the American Statistical Association* 31:610 for references to this study and the analyses of Osburn). The field work of a new nationwide study of expenditures was completed in 1936 as a basis for revising these weights so that they would “more nearly approximate presentday consumption. . . . Pending this basic revision in weights, several important revisions in method have been incorporated in the indexes beginning with the March 15, 1935 period, and the . . . indexes have been revised back to the base years” (863:2). The changes were described in an earlier article (868); for preceding history see references cited in (808:445). The new weights derived from the 1934-36 study of expenditure patterns of groups in fifty-five cities were used for the first time in the June 1939 cost-of-living index. The data of this extensive study are now beginning to be published (see *Journal of the American Statistical Association* 34:378 for an outline of plans). A general discussion of the study, with data from various cities, appeared in the *Monthly Labor Review* from time to time (830). An even more extensive study of expenditures for families on *all* income levels in thirty-two cities was undertaken by the Bureau of Labor Statistics and the Bureau of Home Economics in cooperation with the National Resources Committee and the Central Statistical Board (779, 815, 827, 855, 867). The base period of certain of the index series also may be changed (850).

The Bureau of Labor Statistics wholesale price index underwent a change in computational procedure in 1937 (790) as part of a general reconsideration of the series. Begun in 1890, the index number was calculated from 1908 through 1936 as a chain index; since January 1937 it has been computed on a fixed base. Reasons for the change in the base, as well as references to earlier indexes, were given in the reference cited. The formula remains that of Laspeyres (Fisher’s No. 53) with weights revised from time to time.

The retail price of foods index has been receiving its share of attention. The current methods of collecting data, and the forming of a Conference on Price Research in November 1935 to coordinate the interests and insights of various groups, were described in the *Monthly Labor Review* for January 1936 (p. 253-54) and March 1936 (p. 836-37). To follow the work of the Bureau on these and other indexes one should consult files of the magazine just mentioned, and the notes of the Bureau of Labor Statistics in current issues of the *Journal of the American Statistical Association*.

Price Levels, Cost of Living, and Purchasing Power

The changes in the cost-of-living index referred to in the preceding section are a part of a general ferment in this area of index numbers. Surging with the zest of mathematical exploration and development of an underlying principle, activity on the theoretical side of cost-of-living indexes has been notable during the past few years. The discussion grows out of the influence of a psychological principle in consumption, leading to the fact that a cost-of-living index is not so much concerned with reflecting changes in the cost of a fixed set of items as it is in reflecting changes in the cost of a given standard of living—a general level of satisfaction. As prices change for a given income, or as income changes out of proportion to prices, individuals will seek to obtain, or to maintain, as large an amount of satisfaction as possible under the new conditions—which means that the pattern of expenditures (the ratios between the quantities of different items which are purchased) will change. The individual may in fact buy many entirely different things. This condition makes cost-of-living index numbers which are based on exactly the same items from time to time somewhat academic and artificial.

In order to obtain a cost-of-living index number (or various series of indexes) for different income groups, and in order to modify properly the quantity weights in these indexes when prices change, it is necessary to know or estimate how the patterns vary under the influence of three principal factors—prices, income, and size and composition of family. Or, from another angle, it is necessary to know what the conditions are which determine when two different expenditure patterns represent the same standards of living, or of satisfaction.

A large number of field surveys, in addition to the two large undertakings mentioned in the preceding section, have been made to study family expenditures (772, 869, 870). It is the mathematical analysis of these data to determine the interrelationships mentioned that has produced the articles above referred to. The analysis involves concepts of Engel curves, Konüs inequalities, indifference curves and surfaces, indicators, and the modern mathematical theory of utility, exchange, and demand. The approaches and interpretations are not all in agreement, and whether a conclusive solution has been reached remains to be seen. The discussion has appeared principally in *Econometrica* and in the annual proceedings of the Cowles Commission; one may consult these seriatim, or trace the principal arguments in the following references by Frisch (802, 804), Bowley (778), Menderhausen (824), Wald (864), Schultz (856), Konüs (817), Allen and Bowley (772); also in papers in the *Report* of the third conference of the Cowles Commission (788) by Frisch; and in the *Report* of the fourth conference (787), papers by Petersen, Wald, and Allen.

Ferger (799) contended that an index number for measuring purchasing power should be a harmonic average of costs; his paper is discussed by Lewis (820).

General Economic and Business Indexes

Lists and indexes of series—Davenport and Scott (791) in 1937 prepared an index to more than 200 business series, with a general description of each and the name of the publication in which it may be found. The National Association of Purchasing Agents (836) in 1937 issued a list including a brief discussion of thirteen leading commodity index number series. Data back to 1913 were given and graphed for each index series. Black and Mudgett (775) listed a number of indexes related to agriculture. Croxton and Cowden (789) referred to a number of series; Fisher (800: 432-38) listed 85 discontinued series, 99 current series in foreign countries, and 34 current series in the United States. Citations will be found in these sources to other sources and to earlier lists. See also the following paragraph.

Important new series—Cowles and associates (786) prepared a notable set of stock indexes, running back to 1871. Cole (783) supervised work on wholesale prices running back to the beginning of the eighteenth century—as part of the work of the International Scientific Committee on Price History. Hickernell (810) also produced some series of historical value—1815-60. Johnson (814) reported a new index on physical volume of business to replace the former indexes of volume of trade. Many other series of more or less recent origin will be found in the lists cited in the preceding paragraph.

Discussions of uses, values, and shortcomings—Without attempting to list all the recent articles on economic index numbers we may cite a number of them which throw light on practical applications and interpretations of these series. These discussions are of value to those educators who are concerned with the economic background of education and educational support—and also to those who wish light on the interpretation of index numbers, whether economic or not (782, 792, 819, 823, 825, 861, 865, 866). Other articles, some more theoretical, will be found in issues of the *Journal of the American Statistical Association*.

The Construction of Index Numbers

Methods used in preparing current series—Descriptions of the method of preparing a number of series of indexes prior to 1936 were cited (808: footnotes p. 226-29, and p. 449-53). Actual and contemplated changes in the preparation of the Bureau of Labor Statistics indexes have been presented in earlier sections. A full description of the methods used by the National Industrial Conference Board in its cost-of-living index was given by Beney (774). McIntyre (821) described a tabulating machine procedure.

Discussions of problems of construction—The classic discussion of problems and methods of preparing index numbers, by Mitchell, first published

in 1915, revised in 1921, and long since out of print, has been republished (826). We quote one passage as a contribution to perspective:

To judge from the literature about index numbers, one would think that the difficult and important problems concern methods of weighting and averaging. But those who are practically concerned with the whole process of making an index number from start to finish rate this office work lightly in comparison with the field work of getting the original data. (826: 25).

Other discussions of problems in index number construction are given by Black and Mudgett (775), Hudson (812), and Perlman (848). Montgomery (829) wrote on "the mathematical problem"; reviewers have found it difficult to sense his problem.

Sampling—This topic, which appears incidentally in many discussions of method and of use of index numbers, has been dealt with explicitly by Hanna (809), Hudson (812), Neyman (844), and Schoenberg and Parten (855). It is treated, whether by this or some other title, in most descriptions of field work in gathering data for current index numbers; the selection of cities, of outlets or sources, and of individual items are all practical phases of sampling (826).

Adaptation of formula to tests and to purposes—Fisher (800: 229-34, 523-31) selected an "ideal" formula on the basis of certain formal tests and contended that it was ideal for all purposes. Apparently, however, he was thinking only of a certain limited group of purposes; other writers have differed sharply with his contention, and have enumerated other purposes which clearly call for different index number formulas; see McIntyre (822), Mitchell (826: 23-25), and Black and Mudgett (775). King (816: 55) regarded all formal tests as inconsequential. Frisch (803) developed a formula which would meet certain formal tests, and pointed out certain incongruities between the tests. Smith (858) analyzed an index number series in terms of related factors in an attempt to check its validity.

Weighting Index Numbers

Discussions—The question of weighting is an old one and has been debated at length. The type of formula used controls certain aspects of the weighting: see Arthur (773), Evans (798), and Garver (807). Fisher's selection of the "ideal" formula because of its internal weighting relationships is well known. The more general problem of weighting concerns the weights to be assigned to elements at any given time or observation point: see Mitchell (826: 59-68), Black and Mudgett (775), and Johnson (814). The discussions of weighting for cost-of-living index numbers, and the studies of expenditure patterns, already cited, are pertinent here.

Practical experiments—As to the importance of weighting of elements, experience as well as opinion differs. Allen and Bowley (772) showed a variation of 16 percent in cost-of-living index numbers when different weights were used; the Bureau of Labor Statistics finds only 2 percent variation.

To ascertain experimentally the effect of weights on index numbers which have been used in educational work, Scates and Fauntleroy (851) applied arbitrary weights ranging from 1 to 11, and rotated these weights between the criteria according to a fixed scheme so as to see what effect the changing of the weights would have on the resulting index numbers. The weights were applied to five series proposed by the National Education Association, using both the actual and the rank value forms of the data; as a third study, the weights were applied to 11 series used by Schrammel and Sonnenberg; as a fourth study, they were applied to 15 traits used by Chamberlain; and as a fifth study, they were applied to 8 elements of a teacher cost-of-living index. The results were analyzed both in terms of correlation and in terms of rank or actual displacement in the resulting index numbers. Average correlations for the first four studies ran .97, .95, .86, .95; average displacements in rank (the series having 48 ranks) were 2.5, 3.0, 4.8, and 4.1. For the cost-of-living index number, the average difference was 1.4 percent—the maximum difference observed being 6.5 percent. The conclusions were that weighting is sometimes important, though generally not; it is of most effect when the extreme (high or low) weight is applied to a series which is highly unique, but when an extreme weight is applied to a series having a high correlation with the remaining series the weight has little effect. The factor of weighting cannot be considered by itself; it is connected with the uniqueness of the various traits.

Formal criteria—proposals have been advanced by Horst, and by Wilkes (both discussed in Chapter XV of the present issue), and by Edgerton and Kolbe (795) for determining the weights of composites according to specified “internal” or statistical criteria. Whether these technics afford answers to some of the problems of weighting in index numbers remains to be seen.

CHAPTER XV

Statistical Methods¹

PALMER O. JOHNSON

THE EXTENSIVE REVIEW by Cureton and Dunlap of statistical literature having special application to test construction and analysis, in the June 1938 *Review of Educational Research*, supplemented by the bibliography of Scates in the December 1938 issue, and the treatment of factor analysis and of index numbers in the chapters immediately preceding this one, permit delimitation of the present review. Moreover, the time available and the space allotted to the topic preclude an exhaustive and thorough discussion. It has however seemed advantageous to include a number of pertinent developments in other fields than education. This proved to be difficult, as the selection of material having special significance for research workers in education, out of the vast amount of statistical literature which is so rapidly developing, cannot avoid being somewhat arbitrary.

The main role of statistical analysis in research may be specified as: (a) providing a secure basis for the planning of the investigation, (b) affording appropriate tests of significance to determine the existence of a real effect, (c) providing methods of obtaining the best unbiased estimate of the effect found to exist, and (d) furnishing efficient means for the reduction of data.

The studies cited have been classified under the following headings, not necessarily mutually exclusive: (a) statistical methods and the planning of investigations, (b) analysis of variance and covariance, (c) correlation and regression, (d) the testing of statistical hypotheses, and (e) the problems of sampling.

Bibliographies and Books of Recent Statistics

Among helpful bibliographies or studies including bibliographies should be mentioned those of Buros (879), Dunlap (893), Rider (932, 933), Preston (930), Shewhart (939), and Swineford and Holzinger (948).

Significant publications on general mathematical foundations of statistical theory and practice were those of Deming and Birge (891), Fisher (898), and Wilks (959).

Statistical tables of recent publication that should prove of substantial value to research workers were those of Fisher and Yates (899), and Kelley (919). The tables by David (889) brought together the fundamental treatises on the tests of significance for r and greatly facilitated the testing of any hypothesis as to the magnitude of correlation values.

¹ Bibliography for this chapter begins on page 626.

Statistical Methods and the Planning of Investigations

The development of experimental technics is closely related to the question of efficiency—with how much information it is possible to make the experiment yield. Experimental work may be carried out in a number of ways, but an efficient technic is based upon a knowledge of fundamental principles, of the methods available, and familiarity with the sources of variation in the experimental material.

Due chiefly to the contributions of R. A. Fisher and his students, the principles of experimentation represented in agricultural experiments are more highly developed than those in any other field. One of the most significant principles is that of regarding statistical analysis and the design of the experiment as but two aspects of the same problem. Research workers in education could profit much by observing this principle; in general we have not been critical in the fulfillment of the conditions which render our data amenable to extended statistical analysis. The best single treatment of the principles of experimentation was given by Fisher (896). Of especial import is the concept of the self-contained experiment and the rigorous discussion of the rationale underlying the requirements of a self-contained experiment. The objective of making an experiment self-contained is to provide a validated, unambiguous interpretation of the experimental results without reference to other experiments or to previously accumulated experiences. The need for supplying a control and the necessity for the experiment containing within itself the provision of a valid estimate of experimental errors, as well as an unbiased comparison between the factors tested, are the fundamental aspects of the principle of making an experiment self-contained. The role of randomization in experimental design is succinctly treated, which should correct the rather common misunderstanding that the purpose of randomization is to increase the precision of the experiment. On the contrary, the aim of randomization is to guarantee that whatever precision the experimental arrangement can provide is neither overestimated nor underestimated.

Particularly suggestive as forms of experimental design are the incomplete randomized blocks and the factorial experiments, discussed by Yates (965, 967) and Fisher (896). These principles of design are of general utility whenever dealing with variable materials—for example, comparing the effects of different dietary treatments on school children; studying nature and nurture through the use of monozygotic and dizygotic pairs of twins; ascertaining certain factors underlying growth in learning; and the like. The limited utility and the doubtful validity of the so-called "law of the single variable" in dealing with biological materials—a technic which receives much attention in theoretical discussions of the scientific method—are well brought out when contrasted with these efficient methods of design. The combining of several single lines of inquiry into a single large factorial experiment, where the factors are varied concurrently in the different

possible combinations, is a decidedly more efficient form of arrangement than the customary method of using one factor as a control. In the factorial type of design, all treatment comparisons are of the same accuracy. Moreover, this accuracy is the same as that between the control and the other factors in the customary type of arrangement with an equal number of experimental units. The possibilities of these forms of design in rendering unnecessary the application of partial and multiple correlation technics frequently applied to similar problems are promising.

Johnson (917) discussed and illustrated the relations between statistical methods and the design of experiments in education and psychology. Snedecor (942) brought out the relationship between efficient experimental design and improvement of statistical technics in biology. Fisher and Yates (899) illustrated the application of the incomplete randomized block form of arrangement to data taken from Crew's study (886) of the inheritance of educability. Crutchfield (888) pointed out the possibilities of the application of factorial design to psychological research and has applied this form of design in the study of five factors as determiners of energy expenditures in string-pulling of the rat (887). Chapin (882) treated the problems in the design of social experiments and educed a pattern of practical procedure which will be found useful to workers in education. Peters (929) pointed out that certain features, such as extended measurement, the use of tests valid for measuring the presumed differences between the groups under comparison, and the repetition of experiments, would increase the reliability in controlled experiments.

Analysis of Variance and Covariance

The uniformly most powerful tool for research workers is probably the analysis of variance, developed by Fisher (896). Fisher described this technic as "the arithmetical procedure by means of which the results of an experiment may be arranged and presented in a single compact table which shows both the structure of the experiment and the relevant results in such a way as to facilitate the necessary tests of significance." It provides the mechanism by which the total variance in a record of observations may be broken down into parts traceable to specified sources. It is unfortunate that such a valuable technic has been so long neglected in the field of educational research, for it has rather wide application. It may be applied, for example, in testing out the homogeneity of any number of samples with respect to measures such as intelligence, achievement, and the like.

An excellent illustration of the power of the analysis of variance was afforded by its application by Fisher and Gray (897) to the examination of the value and reliability of the data from Boas's study on *Changes in the Bodily Form of the Descendants of Immigrants*. Lev (923) applied the method to the evaluation of test items of the multiple-choice type.

The analysis of variance, with the use of the Z-test is perhaps the simplest test to use in examining the reliability of regression coefficients and correlation—both simple and multiple—as well as for testing linearity of regression.

The method of covariance described by Fisher in 1932, by which corrections can be made in observational data for variations in one or more correlated variables, provided a technic for dealing with the problem of covariation in the case of heterogeneous data similar to the single variable problems treated by the mechanism of the analysis of variance. The introduction of the analysis of covariance provided a means of further control of errors that arise in experiment and are usually incapable of control. One interesting application of the analysis of covariance was made by Snedecor (940) in an endeavor to institute a statistical control of a departmental grading system for students in mathematics. Increased precision resulting from the application of the analysis of covariance was also demonstrated by Wishart (961) in his growth-rate determination in nutrition studies. Wishart (962) also dealt with the problem of the calculation of the standard errors for means when adjusted for regression.

Fertig (895) pointed out what had previously been stated by Fisher (898), that where the two samples of observations are paired the method of differences may be employed. When two samples are independent, more degrees of freedom are available for estimating variance, so that in paired observations the basic characters of matching must be sufficiently highly positively correlated in order to offset the loss in precision resulting from estimating the variance from the reduced number of degrees of freedom. Barr and Mills (872) presented a short method of calculating the standard error of the difference of the means of paired items. This method is the method of differences and, based on the same number of degrees of freedom, gives identical results obtained from the more laborious method of application of the standard error of the difference between means of correlated measures. Welch (956) formulated a test of the significance of the difference between two means when the population variances are unequal.

Certain theoretical conditions underly the application of the analysis of variance. The experimental errors to which the observations are subject should be independently and normally distributed, with the same variance. Means and standard deviations of random samples from a normal homogeneous population are known to be independent. Immer (911) found that a negative correlation appeared to exist between the mean yield of plots and the standard deviation of samples within these plots for uniformity of trial data. The condition of uniform variance is a more important restriction than that of normality. Cochran (883) showed that for certain types of nonnormal data it is possible to make certain transformations by which skew distributions may be changed into distributions

which are approximately normal with the same variances; among the transformations illustrated, the logarithmic transformation proves useful in dealing with new material of unknown distribution. This may be the case in dealing with certain kinds of educational and psychological data. Cochran (883) illustrated how the logarithmic transformation could be applied to a set of reaction time data when it was observed that the standard errors of the original data were proportional to the means. Bartlett (874) discussed the advantages in using the square root transformation in the analysis of variance as a means of stabilizing the variance when the variance is proportional to the mean.

Friedman (901) proposed the use of ranks when the assumptions necessary for the valid application of the analysis of variance are not justified. Problems of this nature are rather often encountered in dealing with social and economic data. In his method each set of values of the variate were arranged in order of size, and the ranks were used in the analysis in place of the original quantitative values. The fundamental step in the analysis was the computation of X^2r (chi-square) from the table of ranks. In this method it was impossible to obtain a measure of interaction, but the method proposed by Fisher of pooling the probability values of independent tests of significance enabled the use of more of the relevant information provided by the data.

It will occur quite often in dealing with problems in education which require the testing of homogeneity of a number of samples that the samples are of unequal numbers. In the simplest case of analysis of variance where the variates are grouped according to a single criterion, no difficulty is encountered in the analysis. In dealing with multiple classifications with unequal frequencies in each class, especially if the subclass numbers are disproportionate, real difficulties arise. Snedecor and Cox (941) presented the methods available for analysis of disproportionate subclass numbers in tables of multiple classification: (a) the method of expected subclass numbers, (b) the method of fitting constants, (c) the method of unweighted means, and (d) the method of weighted squares of means.

For a discussion of the theoretical foundations underlying the analysis of variance, publications by Irwin (913, 914) and Hendricks (904) will be found useful.

Correlation and Regression

The correlation coefficient continues as a much overused tool in educational research, likely because of unfamiliarity with other available tools. Burt (880), in a discussion of recent developments of statistical methods in psychology, indicated that the interest of the statistical psychologist is shifting from ascertaining the degree of correlation to the analysis of variance; also that owing to the impression of many that statistical methods could not be applied unless samples were large, the more

accurate and individual studies of the past have been supplanted by vast collections of inaccurate data through the application of group tests. With the development of small sample technics there is likely to be a return to the more accurate and individual studies of the past. Irwin (912) expressed the desirability of summarizing results in a concrete form rather than by a single coefficient. The regression line or curve is more informative than the correlation coefficient or the correlation ratio when the problem consists in relating two quantitatively measurable variables. The relation between a quantitative and a qualitative variable is more concretely expressed by comparing the variation between arrays with the variation within arrays by means of the analysis of variance technic rather than by the correlation ratio. When both variables are qualitative, the difference between observed and expected frequencies in the different cells of the contingency table is frequently more informative than the single coefficient of mean-square contingency.

The many new ways of expressing relationships appear in most cases to be no more than the older method of least squares expressed in a new notation. The problems in psychology for which the correlation coefficient or other coefficients of association are most essential are: (a) where it is necessary to determine which of several variables bears the highest relationship to a given variable, (b) in factor theory, and (c) in certain aspects of test theory and practice.

Sandon (937) approached the problem of selection by means of an examination in a unique manner. Instead of using the method, often employed of comparing the performance of those individuals "successful" in an examination with those who were "nonsuccessful," he began with a theoretical examination correlating .95 with the criterion and observed the effect of selection on the correlation coefficient, and computed the percent of misfits for different values of r and different critical score values. Another part of the investigation consisted in a determination of the effect of selection on the relation of two subjects jointly providing the bases of selection, as well as of the effect on observed relationships of other correlated variables. The significant principle is deduced that "the other test seems to be the better."

Thouless (949) contributed a valuable analysis of the effects of errors of measurement on correlation coefficients. He specified the types of problems for which correction for attenuation is justifiable, those for which the correction is unnecessary, and those for which the correction is wholly unjustifiable. A formula was suggested for the valid application of the correction for attenuation to partial correlations when correction of all the coefficients used is not desired or impossible. The canonical correlation and the vector correlation discussed by Hotelling (910) may be found useful in overcoming certain difficulties not satisfactorily handled by present technics in dealing with reliability coefficients and correlations corrected for attenuation.

Wherry (957) analyzed critically the shrinkage of the Brown-Spearman prophecy formula. He stated that the results from the application of the formula appear to contain both constant and chance errors. The shrinkage of the Brown-Spearman formula can be satisfactorily predicted by the Wherry-Smith correction formula. Remmers and Whisler (931) pointed out that test reliability is a function of the method of computation. Rulon (935) presented a simplified procedure for determining the reliability of a test by split-halves. In place of the usual method of obtaining the standard error of the score, i.e. $\sigma_{(meas.)} = \sigma \sqrt{1-r}$, he showed that the process can be simplified by computing the standard deviation of the differences between the scores on the halves of the test, which gives the estimated standard error of the score from the whole test.

Harsh and Stevens (903) reported the construction of a mechanical correlator. Raw data are entered into the machine in the form of steel balls. By means of a few mechanical operations, the regression coefficients are obtained. The correlation coefficient is obtained with the aid of a slide rule by taking the square root of the product of the two tangents.

Two valuable studies dealing with rank correlation have recently been published. Hotelling and Pabst (909) stated that the rank correlation is of especial value as a test of the presence of correlation without the need of assuming normality or other special bivariate distributions. The significance of rank correlations in small samples was determined by calculating exact probability values by means of permutations. For samples of five, it was shown that significant values cannot be obtained ($P = .01$) when n is not small enough for the ready determination of exact probabilities; the Tchebycheff inequality is serviceable but, in general, does not lead to an accurate approximation of P . The efficiency of rank correlation in estimating P if P is really zero was found to be about 91 percent. An illustration was given of combining the information from two independent tests of significance, the interpretation of sex differences in achievement in a school subject. The procedure, according to the method given by Fisher, consisted of adding the natural logarithms of the two probabilities, multiplying by two, and obtaining the probability value for chi-square with four degrees of freedom. Kendall (921) worked out a new measure of rank correlation which may be applied to such usual types of problems as: (a) where an observer arranges a known set of weights in ascending order and (b) two observers rank a set of musical compositions in order of preference. The measure employed was the ratio of achieved score to maximum possible score. The sampling distributions of the statistics were determined.

A number of studies of multiple and partial correlation and regression are of recent publication. Kurtz (922) presented a modification of the Doolittle method of solving normal equations in which a single forward solution provides the necessary data for $\frac{(n-1)(n-2)}{2}$ multiple correlation coefficients; or the multiple correlation between each of several criteria

and the same set of independent variables may be computed with only slightly more labor than is required to obtain the multiple correlation between a single criterion and the independent variables. Horst (908) developed a method for securing a composite measure from a number of different measures of the same attribute; for instance, obtaining a composite measure of scholastic ability from a number of measures, such as achievement test scores, intelligence test scores, grades, and the like. An equation was presented which gave the weights to be assigned the separate measures in order to derive the composite score. The linear combination of the original measures gave composite measures such that the sum of squares of the differences between all possible pairs of measures was a maximum. Wilks (960) presented methods providing weighting systems for linear functions of correlated variables when there was no dependent variable. Three methods were presented for determining the "best" set of weights for combining subtest scores into a final score, for small values of n : (a) choosing weights such that the generalized variance of the subtest scores of all individuals with a linear score based on such weightings is a minimum, (b) determining weights equalizing the correlation between each subtest and the total linear score, and (c) deriving weights which equalize the increments of the total score variance by including each subtest with the remaining subtests. Blankenship (876) presented a method for obtaining regression and standard error calculations from normal equations.

Fisher (898) had an excellent method for the solution of simultaneous linear equations, particularly when solutions for more than one system of dependent variables for the same set of independent variables were desired. His solution led directly to the attainment of the standard errors of the partial regression coefficients. The method was also highly advantageous for obtaining multiple regression equations when one or more of the independent variables was eliminated. Mosak (926) presented a later development for adjusting the regression coefficient for the omission of variables. Tucker (953) presented a lucid explanation of the method for finding the inverse of a matrix, an essential procedure when the parameters of simultaneous linear equations are to be represented as the expression of the constant terms of these equations. Wherry (958) derived two formulas for estimating beta coefficients, which should be of value in obtaining ready approximations. Wren (964) proposed a method for the calculation of partial and multiple coefficients of regression and correlation, based on a simplified method of solving systems of linear equations by determinants.

Travers (952) applied a method developed by Fisher (900) to obtain the particular combination of test scores which best discriminated between two occupational groups, successful engineer apprentices, and successful air pilots. The discriminant function should prove to be a very valuable

technic in the field of educational and vocational guidance. Wallace and Travers (955) made use of this technic in their study of a group of specialty salesmen.

Travers (951) attempted to develop a means of eliminating the influence of repetition on the score of a psychological test. A statistical method of deriving weightings for each item in a test was set up, the weighting coefficients being linear functions of the difference between "expected" score at retest and observed score at retest. The criterion for the weighting coefficients is that the difference between the sums of the products of the test and retest totals with the weighting coefficients equals the difference between the sums of the products of the test and the expected totals.

The Testing of Statistical Hypotheses

While it is becoming common to attach a standard error or probable error to a statistic in educational research, the addition frequently serves no more than an ornamental purpose. In order to have meaning a standard error must be of known validity: for example, the standard error of a sample coefficient of correlation, as usually calculated, has no real meaning unless it can be assumed that the population distribution is of normal form. There is much confusion between problems of estimation and problems of tests of significance. The problem of estimation consists of selecting the most efficient statistic by means of which the best unbiased estimate may be obtained of the unknown population parameter. A test of significance is the process of examining the reliability of data. One should select the test of significance appropriate for a specific purpose. The purpose is to test a particular hypothesis. The problem in the testing of statistical hypotheses is to determine whether it is likely that certain parameters have specified values.

Johnson and Neyman (918) presented tests for a number of linear hypotheses with particular application to educational problems. The properties an educational problem must possess in order to be translated into the form of a hypothesis to be tested were discussed. Problems of estimation were also considered. Of special significance were the means presented for elimination of inequalities in basic characters of groups under comparison, rendering unnecessary and undesirable the usual practice of matching individuals or certain basic characters for experimental purposes. Setting up a "region of significance" provides a means of specifying the region within which, for values of the basic characters, the hypothesis under test is rejected. Johnson (916) extended the application to additional educational problems. Walker (954) discussed some fundamental concepts underlying generalizing from sample to population. Among the significant topics treated are random sampling, sampling distributions, estimation, probability and confidence, and the steps in testing a statistical hypothesis. Research workers should profit through reading

this rigorous and clear discussion. It has not been possible to include in this review any substantial proportion of the extensive statistical literature dealing with statistical inference, the testing of hypotheses, fiducial probability, confidence belts, and related problems. The publications of Deming and Birge (891), Rider (933), Shewhart (939), and Wilks (959) dealt with the theoretical foundation of these problems and contained reviews and bibliographies of fundamental studies. Pearson and Lekar (928) indicated the major requirements for the development of efficient working tools by the theoretical statistician for the research worker.

The theory of testing statistical hypotheses and of estimation was applied by Jackson (915) to the problem of determining the reliability of mental and achievement tests. He introduced a new concept, the sensitivity of a mental test, which has distinct advantages over the reliability coefficient. In this significant contribution four separate problems have been treated: (a) the determination of the trial effect, (b) the determination of whether or not the test actually measures the capacity of the individuals tested, (c) the estimation of the trial effect if it is found to exist, and (d) the estimation of the relative importance of the random errors of measurement with respect to true measures in determining the individual test score.

The chi-square test—Another very much neglected statistical tool in educational research is X^2 (chi-square), which is essentially a test of significance, or a means of testing statistical hypotheses. While not limited to such problems, it is the most appropriate test of significance to use when dealing with data in the form of frequencies which characterize attributes. Merrill (925) used chi-square in testing whether or not test items are heterogeneous with respect to difficulty and also with respect to validity. Word and Davis (963) applied chi-square to determine the significance of the differences between distributions of initial scores and of retention scores. Recent publications by Fry (902), Berkson (875), and Camp (881) treated the theoretical foundations of the chi-square test and some difficulties in interpretation.

Yates (966) considered the problem of testing the independence of contingency tables involving small numbers, introducing the *correction for continuity*. Sukhatme (947) derived tests of significance for samples of the X^2 (chi-square) population with two degrees of freedom, showing that an extension of the t-test can be made for the significance of the difference between lowest values in two samples; also a test analogous to the analysis of variance tests is proposed for testing the significance of the ratio of the standard errors in two samples. Stevens (945) derived tests of significance for determining whether a sample or a set of samples can be considered to be in the multinomial distribution. Bartlett (873) stated that testing the independence in a 2×2 table may be regarded as testing the significance of the interaction between the two classifications. He derived a test of the second order interaction in a $2 \times 2 \times 2$ table.

Stevens (944) considered the nature of the distribution of entries in a contingency table with fixed marginal totals. He obtained the mean, variance, and covariance of the sums of entries in any prescribed set of cells, with the condition that no two cells of a set are in the same row or column, and no cell is common in two sets. An interesting application is made to an experiment designed to test out the telepathic powers of a large number of people.

The Problems of Sampling

The problems of sampling are so fundamental that it is difficult to explain why so little consideration is given to them in educational research. Rarely does one find an investigation in which more than cursory attention is given to the nature of the sample providing the basis upon which generalizations are drawn. Yet statistical treatment is made of data when the validity of this treatment depends upon the fulfillment of certain conditions. Problems underlying the choice of a population, the determination of suitable means of access to the population, the unit of sampling employed, the method of selecting the sample, the actual selection of the sample, the means of securing complete data for the units of the sample, tabulation and analysis of data, and the application of the sample data are all important problems for many investigations in education, particularly those of the survey type involving often the use of the questionnaire and the interview. In experimental studies as well, the validity of generalizations depends upon the representativeness and randomness of the sample. Stephan (943) gave a valuable discussion of the problems listed above as they are found in large-scale surveys. Schoenberg and Patten (938) discussed methods and problems of sampling in a study of consumer purchases. Bowley (877) considered the application of sampling to economic and sociological problems. In his discussion of the amount of error in sociological data, McCormick (924) considered factors that are equally appropriate for educational data. Roberts and others (934) illustrated in a series of studies on a child population how informative studies of this nature can become when rigorous and efficient methods of statistical analyses are employed. Among the factors considered were the method of ascertainment of the sample and the form of the frequency distributions, with special consideration of the form of the lower end of the frequency distribution of Stanford-Binet Intelligence Quotients. Merrill's study (925), previously mentioned, considered the role of sampling theory in test item analysis.

Unrestrictive sampling and stratified sampling are methods of random sampling usually considered as aspects of the representative method of sampling. In the former, single individuals are drawn at random from the population, with or without replacement; in the latter, the population is divided into several strata and the sample is composed of partial samples,

each being drawn at random from one or other of the strata. The method of purposive selection, sometimes used, involves intuitional dependence on correlation between certain values sought and one or more known values. Sukhatme (946), Neyman (927), and David (890) contributed to the theory of sampling human populations, including discussions of the representative method.

An important statistical problem is that of determining whether or not, given a random sample, it may have come from a certain population either partially or completely specified. One method is to start from the population and to determine the probability that a given sample should have come from this population. Another method is to begin with the sample and to determine the probability that a specified population is the one sampled. In order to examine the reliability of a statistic, it is necessary to know the form of its sampling distribution. Not all these sampling distributions are normal in character. Hey (906) took samples from four non-normal populations and determined the sampling distributions of correlational coefficients, regression coefficients, and variance ratios corresponding to degrees of freedom 3:4, 3:12, and 4:12. He determined that the sampling distributions of these statistics were sufficiently normal to use the usual tests of significance for the four nonnormal populations sampled. An economical method, using the tabulating machine, was worked out for the computations necessary in the sampling investigations. Shewhart (939) and Rider (933) have excellent discussions of developments in sampling theory.

Miscellaneous

Kelley (920) contributed an improved derivation for the determination of optimum upper and lower groups for the validation of test items. Bradway (878) described the use of the Thompson method for studying scale items, validating items, determining the diagnostic value of items, and investigating the handicaps of groups with sensory disabilities. Dunlap (894) studied the relationship between the type or form in which test questions are presented and scoring errors. Hertzman (905) derived equations for calculating the sum or the average of all the possible differences, and the sum of squares of all possible differences, in a distribution of scores. Saffi (936) made a comparison of scales constructed by the method of paired comparison of rank order, and by the method of successive intervals. Hilgard (907) evaluated alternative procedures for the construction of Vincent curves and suggested desirable means for choosing between the various alternatives. Du Bois (892) proposed a time-saving method for computing means and sigmas. Toops (950) published an informative bulletin on Hollerith coding.

CHAPTER XVI

Classroom Experimentation¹

MAX D. ENGELHART²

IN THIS REVIEW an effort is made to bring down to date the corresponding summary of Monroe (981) which was published in February 1934. In that summary and in certain chapters of the texts on educational research technics published in 1936 by Good, Barr, and Scates (973), and by Monroe and Engelhart (984), are included most of the ideas on experimental procedures which the educational experimenter should know today. In the present review there is some repetition of these ideas because of their importance, but the main emphasis is upon certain statistical technics which are new to educational experimentation and which may greatly modify it.

Some years ago the status of controlled classroom experimentation was compared with the plateau in a learning curve (983). Progress seemed to be retarded pending the perfecting of more adequate technics, a condition somewhat analogous to that during learning when lower order habits have been formed and improvement is at a standstill until higher order habits have been developed. There now seems to be some reason to feel that the plateau period has been passed and that progress in experimentation has again acquired some degree of acceleration. While many, and possibly most, of the experiments currently reported in the literature have limitations which have been condemned by competent critics for more than a decade, an increasing number show evidence of serious attempts to avoid these limitations. Furthermore, there have recently developed efforts to create, or to adapt from other scientific fields, technics to overcome obstacles to dependable educational experimentation formerly thought to be insurmountable.

The Experimental Problem and the Experimental Factor

The typical problem investigated by means of controlled classroom experimentation calls for a determination of the relative effectiveness of two methods of teaching, of two kinds of instructional materials, or of two types of class or school organization. One of the compared procedures is administered to the pupils of a given group, while the other procedure is administered to the pupils of an equivalent group. Each group may consist of several classes. The difference between the compared procedures represents the experimental factor or, more precisely, the change in the experimental factor. The difference between the final achievement means, or between the mean gains in achievement, of the pupils of the two groups

¹ Bibliography for this chapter begins on page 629.

² The author is indebted to E. F. Lindquist for a number of valuable suggestions.

is taken as an index of the relative effectiveness of the compared procedures—i.e., of the effect of the change in the experimental factor. Various statistical techniques are employed in efforts to ascertain the dependability of this index.

The experimental factor investigated need not be restricted to the types referred to above. Any factor that can be applied or controlled by the investigator and that may or may not produce measurable effects on the achievement or other traits of children may legitimately be the subject of classroom experimentation. Furthermore, an experiment need not be restricted to the investigation of the effect of one change in a single experimental factor. The effects of different changes in a given experimental factor, or the effects of different experimental factors, may be studied through the use of different and not necessarily equivalent groups. It is probable that many experiments of the type just suggested will be conducted in education as educational experimenters assimilate and adapt to educational conditions the ideas of Fisher respecting the design of experiments (971) and his techniques of the analysis of variance and covariance (972) which are useful in the interpretation of experimental data.

Many currently reported experiments may be criticized for their inadequate definitions of the experimental problem. Unless the experimental factor is clearly defined, the hypothesis tested is vague both to the experimenter and to the reader of his report. The experimental factor cannot adequately be administered to the pupils participating in the experiment, or can the effects noted be safely ascribed to it as their cause. An experimental factor involving a change in method can best be defined in operational terms. For example, instead of defining the method of teaching employed with the pupils of one group as the project method and that employed with the pupils of the other group as the assignment method, the experimenter should state just what specific activities are carried on by the teacher of the first group as contrasted with the specific instructional activities of the teacher of the second group. If materials of instruction are compared, their specific differences should be noted. A similar statement may be made with respect to compared types of class or school organization, or other kinds of experimental factors. The comprehensiveness of definition should be a function of the complexity of the experimental factor investigated.

Control of Nonexperimental Factors

The difference between the final achievement means, or between the mean gains in achievement, of the pupils in two groups is the resultant of many causes. In the ideal experiment, all of the difference is attributable to the change in the experimental factor, and the net effects of other causes are zero. It is the causes whose net effects must be compensating, or zero, which are termed the nonexperimental factors; such factors include

basic pupil traits, instructional procedures and materials not inherent in the experimental factor; zeal, skill, and other characteristics of the teacher; and various influences pertaining to the school, the homes, and the environment of the pupils.

Various technics have been used in efforts to secure control of basic pupil traits or the equivalence of groups. Probably the most commonly used procedure is the matching of pupils on the basis of measures of intelligence. Sometimes the matching is done on the basis of initial achievement measures or a combination of intelligence and initial achievement measures. An occasional experimenter has equated groups on the basis of learning curves or on the basis of composite scores derived from several tests. Possibly, with further development of factor analysis, some experimenter may attempt to secure equivalence by pairing, on the basis of pupil measures, of relevant primary factors and to measure the effect of the experimental factor by a factor analysis of data secured at the close of the experiment. It is possible that the control of pupil traits by matching procedures may receive less emphasis as a result of the use of the variance technics in the analysis of experimental data. It will always be important, however, to seek adequate measurement of basic pupil characteristics in order to account for differences between groups and to formulate generalizations concerning the effect of the experimental factor.

One of the major criticisms of contemporary classroom experimentation concerns the control of nonexperimental factors other than pupil traits (973, 981, 982, 983, 984). Meyers (980) recently produced a study which indicated the continued neglect of experimenters to obtain adequate control of instructional procedures and experience, skill, and zeal of teachers. Control of instructional procedures is most likely to be obtained when the procedures to be used are specified in detail. Care must be taken, however, that such specification does not result in violation of sound educational practice. Experience and skill may be controlled by having the same teacher teach both groups after practice with both of the compared methods or materials. Zeal may be controlled by the teacher's acquisition of a scientific attitude. Control of experience, skill, zeal, and other important nonexperimental factors may best be promoted by providing a number of pairs of groups in a variety of schools, each pair of groups being taught by the same teacher. When an experiment is thus replicated, the chances for compensating systematic errors inherent in noncontrol in the different pairs of groups are increased.

Duration of Experiment

Many contemporary experiments have resulted in inconclusive results because of failure to conduct the experiment over a period sufficiently long to result in a significant difference in achievement. The importance of experimental duration is recognized in a citation of the Committee on

Awards of the American Educational Research Association respecting an experiment conducted by Hardy and Hoefler (974). "After two years of preliminary study of the local situation, a five-year controlled experiment was organized for the purpose of ascertaining the effects of certain health instruction procedures" (968). Recognition of the importance of experimental duration is also characteristic of the investigation of the merits of progressive education being carried on over a period of years under the direction of Tyler (989).

Measurement of Achievement

Much could be written concerning the importance in classroom experimentation of securing valid measurement of the final achievements or gains in achievement of the pupils participating in an experiment. The reliability of the test or tests used is not often a matter of concern, and it is relatively easy to make allowances for the variable errors of measurement which are due to test unreliability. Much greater concern should be given to the validity of the measures employed. A test may be biased in validity and thus cause systematic errors of validity. A mean difference in achievement may be due, not to the inherent superiority of one of the compared procedures, but to the fact that the test is in part measuring certain irrelevant factors which are more prominent in one group than in the other. A frequent cause of this type of experimental limitation is the employment of a test which measures a restricted range of abilities. Usually, an experimental problem calls for measurement of more than fixed associations or motor skills. There is usually an implicit requirement of measurement of more general abilities, including skill in reflective thinking about the subjectmatter of the experiment and of attitudes, ideals, and interests created or modified by the experimental factor. Fortunately, an increasing number of experimenters are recognizing the necessity of comprehensive measurement of all relevant outcomes. The experimentation directed by Tyler (989) may again be cited in this connection.

Testing the Statistical Significance of Observed Differences

The usual procedure in organizing the data of an experiment is to tabulate distributions of the scores of the pupils on the achievement test administered at the conclusion of the experiment. If an initial and final achievement test have been given, gains in achievement may be tabulated, provided that the test forms are equivalent or that derived measures are used. It is more desirable to use gains in achievement than to use final test scores (978). The mean final achievement, or mean gain in achievement, may then be calculated for each group, and the difference in mean final achievement, or mean gain in achievement, next obtained. Another procedure which may be used with paired pupils is to tabulate the indi-

vidual differences in achievement or gains in achievement of the various pairs. The mean of such a distribution is, of course, equivalent to the difference between the final means, or between the mean gains, previously mentioned. After the difference has been calculated, the experimenter is confronted with the problem of testing its dependability.

If the assumption of independent random sampling is satisfied³ and the experimenter has calculated the standard deviations of the distributions concerned, the standard errors of the final test means, or of the mean gains,⁴ may be computed and substituted in the short formula for the standard error of a difference between two means:

$$\sigma_{\text{Difference } M_1 - M_2} = \sqrt{\sigma^2_{M_1} + \sigma^2_{M_2}}$$

In an experiment in which pupils have been paired it is possible, but seldom justifiable,⁵ to compute the standard error of the difference between the final test means, or mean gains, by the formula just given⁶ or to calculate the standard error of the difference between the final test means, or mean gains, through use of the long formula:

$$\sigma_{\text{Difference } M_1 - M_2} = \sqrt{\sigma^2_{M_1} + \sigma^2_{M_2} - 2\sigma_{M_1} \sigma_{M_2} r_{12}}$$

The symbol r_{12} refers to the correlation between the paired achievement measures of the pupils of the two groups. Some authorities have questioned the legitimacy of calculating the correlation between pairs of

³ To satisfy this assumption the pupils would need to be selected strictly at random from the population to which the generalizations derived from the data are to apply. Because of administrative difficulties this is almost never possible or attempted in educational experimentation. Furthermore, to satisfy this assumption for equivalent groups, the groups would need to be equivalent wholly as a result of chance and not as a result of the usual pairing procedure in which eliminations are made of pupils who do not match with sufficient precision.

⁴ If the distributions are final test scores, the formulae are $\sigma_{M_1} = \frac{\sigma_1}{\sqrt{N}}$ and $\sigma_{M_2} = \frac{\sigma_2}{\sqrt{N}}$ where σ_1 and σ_2 refer to the two distributions of final test scores. Where the two distributions are distributions of gains, the same formulae may be used. The symbols M_1 and M_2 then refer to mean gains, and σ_1 and σ_2 are standard deviations of the distributions of gains. If one is dealing with distributions of equivalent initial and final measures of each group, the mean gain of each group is the difference between the means of the initial and the final measures of the group. The standard error of the mean gain of each group is then calculated by the formula

$$\sigma_{M_1 \text{ or } M_2} = \sqrt{\sigma_i^2 + \sigma_f^2 - 2\sigma_i \sigma_f r_{1f}}$$

(Mean gain)

where σ_i and σ_f refer to the appropriate initial and final measures and r_{1f} is the correlation between the paired initial and final measures of the given group (9, 14).

⁵ Groups made up of pupils paired according to the usual technique are not independent random samples. If the pupils of the two groups were selected strictly at random, as described in a preceding footnote, and if pairing could be accomplished without eliminations, the assumption of independent random sampling would be satisfied.

⁶ Generalizations should be restricted to a population of the same distribution of measures for which the groups are equivalent, i. e., intelligence measures or measures on an initial achievement test. This also applies to the use of the short formula where groups are equivalent as a result of chance and no effort is made to pair the individuals in the groups. Successive samples should have the same level and range of basic characters, and, hence, generalizations should apply to similar populations. Use of the long formula does not involve this restriction. See Walker (990).

scores of different pupils, that is, the type of correlation coefficient referred to above. Correlation coefficients are usually calculated for paired scores of the same pupils.

If the individual differences in achievement, or the individual differences in the gains in achievement, of the various pairs of pupils have been tabulated and the standard deviation of this distribution calculated, it is possible to compute the standard error of the mean of the distribution of differences. (The usual formula for the standard error of a mean is used.) As has been mentioned, the mean of such a distribution of differences is equal to the difference between the means of the distribution of achievement measures of the two groups. The standard error of the mean of the distribution of differences is also numerically equal to the standard error calculated through the use of the long formula. Again, since paired groups are usually not independent random samples, the procedure described is seldom, if ever, justified.⁷

If, however, the pupils of one group have been selected at random, an equivalent group is chosen through use of the matching technic, and the correlation between the measures used in matching and the measures of achievement is calculated, the experimenter may legitimately use the formula of Lindquist and Wilks in obtaining the standard error of the difference between the means of the two groups:

$$\sigma_{\substack{\text{Difference} \\ M_1 - M_2}} = \sqrt{(\sigma_{M_1}^2 + \sigma_{M_2}^2)(1 - r^2)}$$

The generalizations should refer to populations having the same distribution on the measures used in matching; populations of the same level and range in intelligence where matching is done on the basis of intelligence measures, or populations of the same level and range in achievement where matching is on the basis of initial achievement measures.

If the mean of the individual differences has been obtained and the standard error of this mean has been computed in the usual way, it may be corrected by multiplying by the term $\sqrt{1-r^2}$ where r here refers to the correlation between the measures used in matching and the individual differences in achievement, or in gains in achievement, of the paired pupils. The generalization should refer to a "universe of individual differences" and to populations restricted as indicated above.

Underlying assumptions—It is not justifiable for an experimenter to employ any of these procedures without seeking an understanding of the assumptions underlying them and the limitations in their use. The interested reader should consult the original papers of Lindquist and Foster (1978), Walker (1990), Lindquist (1979), and Wilks (1991), the discussions

⁷ See preceding footnotes. Ezekiel (1969) has pointed out that the generalizations should refer to "a universe of individual differences," a not very meaningful concept in educational research. This would also seem to apply to the numerically equal standard errors calculated by means of the long formula. Incidentally, the method involving the calculation of the standard error of a distribution of individual differences is credited to Student.

of Monroe and Engelhart (1982, 1983, 1984), the attack on Lindquist and Wilks' formula by Ezekiel (1970), Lindquist's reply (1977), and Ezekiel's rebuttal (1969). If the experimenter is interested in generalizing to a restricted population of which the pupils participating in the experiment are a sample, he should consult the paper of Peters and Van Voorhis (1986).

Combination of measures—Peters (1985) recently contended that experimenters have all too frequently concluded that the two methods of teaching being compared are probably of equal value, though the odds in favor of one of the procedures "may be several hundred to one that it is superior, though somewhat less than the seven hundred and forty to one that the ratio of three indicates."⁸ He also argued for the summing of scores on several achievement tests, and showed that a difference thus obtained should have a greater ratio to its standard error than the ratio obtained from data secured by means of only one of the tests. The effect of variable errors of measurement on the ratio is reduced. Lengthening the final achievement test would tend toward the same result, but for the disturbing effect of fatigue. Peters also held that invalidity of the test used to measure achievement tends to decrease the ratio between the difference and the standard error of the difference. Variable errors of validity, defined by Peters as one type of the chance factors unrelated to the experimental factor, tend to be neutralized in the difference, since the difference is essentially an average. The same errors or chance factors, however, tend to augment the standard deviation of the individual differences and consequently tend to augment the standard error of the difference. Peters also argued that replication of experiments with later ones and appropriate combining of data tend toward an increased ratio between the difference and its standard error.

When experiments are replicated and the data combined, systematic errors pertaining to the various groups tend to compensate each other in the combined means. The difference calculated may thus be freed of the effects of errors which are systematic for single groups, but not for the total. The standard deviations of the pooled data will be augmented, however, and the standard errors obtained from them spuriously high. While this limitation should result in the derivation of conservative conclusions, the limitation may be avoided by use of the technics of the analysis of variance.

Analysis of variance—When the analysis of variance technics are used, the effects due to different factors are segregated. Given an appropriately designed experiment, one can test the relative significance of the employment of different teachers, different schools, different methods of instruction, different materials of instruction, and other causes, with reference to each other and to the experimental error—where the last named refers to variable errors of measurement and of sampling and to other

⁸ McCall's experimental coefficient equals unity, the critical point, when the difference is 2.78 times its standard error and the odds are 369 to 1.

irrelevant factors. With this technic, the equating of groups diminishes in importance and we draw away from the classic emphasis in experimentation of "varying the essential conditions *only one at a time*. . . . This ideal doctrine seems to be more nearly related to expositions of elementary physical theory than to laboratory practice in any branch of research" (971).

Use of the variance technics was advocated by Lindquist and Dunlap at the February 1939 meeting of the American Educational Research Association. After brief reference to the advantages of the variance technics, Lindquist concluded with a timely admonition: "Let us hope that, as we first briefly glimpse these possibilities, we will not rush to apply these technics with the excess of zeal and the lack of critical consideration which have so often characterized our first uses of new technics in the past" (968).

Johnson-Neyman technic—At the same meeting, Johnson described a technic which he and Neyman (975) have developed and which represents an outgrowth of technics devised by Fisher. This procedure has the general purpose of determining the significance of differences between the achievement measures of two or more groups. The groups may be equivalent, but this is not essential. In fact, one can use the technic in testing hypotheses concerning the effectiveness of a given educative factor, or of contrasted educative factors, where the groups differ in one or more basic characters. The investigator can avoid the administrative difficulties inherent in efforts to set up paired groups prior to the application of an experimental factor, or the loss of data usually occurring when pairing is carried out subsequent to experimentation. The number of basic characters considered need not be restricted to measures of a single trait—for example, intelligence test scores. In most controlled experiments such a restriction occurs because of the complexity of matching on the basis of more than one criterion. Finally, the technic of Johnson and Neyman takes into account the relationship between the initial and final achievement measures. It does not treat them as independent. In a recent letter to the writer, Johnson named the following additional uses of the technic:

(1) The significance of the differences between partial regression coefficients and between multiple regression equations can be tested.⁹

(2) A region of significance can be set up, such that for values of the basic characters lying within this region the hypothesis (i. e., the null hypothesis that there is no difference in the means under comparison) would be rejected. In this way, the inferences drawn need not be restricted to the specific mean values of the basic characters of the samples under consideration. Setting up the region of significance, therefore, makes use of more information given by the samples concerning the population values.

According to Lindquist, the technics of Johnson and Neyman assume simple random sampling of pupils, a limitation which restricts their

⁹ Kimball (976) also devised technics involving the comparison of regression equations based on experimental data. The procedure yields an estimate of whether or not the same difference can be expected for all values of X, the basic character, by testing the significance of a difference between regression coefficients. This contribution is also an outgrowth of the work of Fisher.

application in educational research. Fisher's technics serve the same purposes better since they are more conveniently applied to samples consisting of intact school groups.

The reader interested in obtaining further information concerning these new technics should consult the papers mentioned (975, 976), the texts by Fisher (971, 972), and the monograph and text by Snedecor (987, 988). Unfortunately, for educational workers, these texts were written for the fields of biology and agriculture. There is a definite need for a text which will clearly demonstrate the applications to experimental educational research.

A Concluding Statement

An effort has been made herein to indicate the trend in controlled experimentation in education. This trend will represent progress if applications of the new technics and scientific attitudes are concomitants. As time goes on, we anticipate more dependable solutions to problems concerning the effects of various educative factors and, in consequence, more defensible decisions regarding what should be done in the practice of education.

CHAPTER XVII

Laboratory Investigations¹

L. C. GILBERT

THE LABORATORY ATTACK upon educational problems is admittedly tedious, expensive, and limited to relatively small numbers of subjects. Nevertheless, the objectivity and accuracy of the laboratory technics qualify them uniquely for the investigation of fundamental principles underlying learning and the nature and capacities of the child. Research reports during the past three years have indicated increased interest in the development and refinement of laboratory apparatus and technics, and in their application to educational problems. The statistical aspects of experimentation are treated in Chapter XIV of this issue of the *Review*.

Eye movement studies have been the most numerous largely because of the mechanical excellence of the present photographic apparatus, the wealth of background data, and the general recognition of eye movements as objective symptoms of what transpires in the central nervous system. Electro-encephalography, formerly confined to medical and psychological studies, has recently been employed in an investigation of brain potentials in oral and silent reading. Brain potentials, like eye movements, are recognized as indicators of activity within the central nervous system and laboratory studies in this field may be expected to yield information highly important for the understanding of child development and learning.

To an increasing extent laboratory studies are manifesting a tendency to cross educational boundaries into such fields as music, neuropsychiatry, medicine, anthropology, and optometry. One study, for example, inquired into the relationship between basal metabolism and intelligence, another investigated the effects of oxygen deprivation on reading. Because of the interdependence of visual, physiological, psychological, and educational factors this tendency is to be regarded as scientifically sound.

Also encouraging is the increasing interest of investigators in developing or adapting instruments and procedures for the study of their own particular problems. While much of the apparatus described in the studies possesses obvious limitations, and is of limited use, the tendency reflects a dynamic research attitude. Certain important reports have been summarized and are presented to illustrate these trends.

Eye Movement Studies

Extension, refinement, evaluation of investigational technics—Recent investigations reported by Buswell (997) and by Tiffin and Fairbanks (1043) employed eye-voice cameras designed to produce simultaneous graphic

¹Bibliography for this chapter begins on page 630.

records of eye movements and voice; phonograph recordings provided permanent reproductions of the vocal performance. A small portable binocular camera intended to make possible the photography of large numbers of subjects was described by Taylor (1042).

Tinker (1045) measured the accuracy of motor control of sixty-four university students and found no significant correlation between accuracy of visual fixation and reading proficiency except in extreme cases. Sisson (1038) presented evidence tending to discredit the usefulness of the concept of "short lived motor habits," that is, of characteristic rhythmical series of the same number of pauses per line and patterns involving a long initial pause, several pauses of decreasing length, and a final rather long pause.

From a study of visual factors in reading, Imus, Rothney, and Bear (1018) concluded that for Dartmouth freshmen the Ophthalm-O-Graph is unreliable, not a valid measure of reading ability where standardized tests are criteria, and that scores are not closely related to academic achievement and cannot be used for individual diagnosis or for grouping for remedial reading instruction. It would appear that the reading materials selected are largely responsible for these findings. Anderson (994) found most eye movement measures valid enough for group comparisons. Tinker (1044) pointed out that experimental evidence indicates that eye movement records of reading are reliable for individual diagnosis if twenty-five or more lines of print are employed, and that validity is low if eye movement measures are compared with test scores when the reading materials are not comparable; if strictly comparable materials are used, perception time and fixation frequency are highly valid measures.

Further data on the electrical recording of eye movements were reported by Mowrer, Ruch, and Miller (1032), who advanced the corneo-retinal hypothesis that there is a persistent potential difference between the back and front of the eyes and that galvanometric effects are associated with changes in the electrical field. Halstead (1013) effected quantitative recordings of horizontal and vertical movements with the eyes open and closed and with the subject moving and at rest; changes traceable to the corneo-retinal potential were detected, amplified, and recorded by means of electrodes attached about the orbits, a shielded cable, appropriate amplifiers, and connected markers. Fenn and Hursh (1007) reported that in any one individual the potential tends to be constant, but that it varies from individual to individual. Hoffman, Wellman, and Carmichael (1017) compared quantitatively the relationships between voltages produced by eye movements and the extent of these movements as recorded simultaneously on film, and reported sufficient reliability of the electrical method to justify its use for quantitative recording in research.

Identification of eye movement characteristics—Gray's summaries (1011) of investigations relating to reading included a number of eye movement

studies: among them, LaGrone's report (1025) on the eye movements of deaf children, Fairbanks' study (1005) of the eye movements and voice in the oral reading of good and poor readers, Swanson's identifications (1041) of common elements in oral and silent reading of poor readers, and a study by Anderson and Swanson (993) of the relationship of eye movement measures in oral and silent reading. McFarland, Knehr, and Behrens (1028), studying the effects of oxygen deprivation on reading, reported a decrease in precision, comprehension, and efficiency of ocular movements; subjects tended to acclimatize at oxygen percents of 12.5 but not 10.5; the average reading time per line and adjustment during fixations appeared to be sensitive measures of anoxemia.

Eye movement training experiments—Sisson (1037) equated three groups on the basis of reading test scores, trained one group in fixating material when and where it was assumed fixations should fall, trained the second group to read comparable material for speed and general meaning, and used the third as a control. Eye movements were photographed before and after a four-week training period. He concluded, that for rate, eye movement training was no more effective than reading with intent to improve, and suggested the possibility of decreasing comprehension by directing attention to ocular process. Had eye movement measures been used in equating the groups and had systematic tests for comprehension of camera material been employed, a more direct appraisal of the technic would have been possible.

In a comprehensive study by Buswell (997) visual examinations, reading tests, information indices, eye movement photographs, and vocal records were used to appraise the reading of 1,000 adults ten years or more out of school. His first remedial training experiment emphasized comprehension, the development of a broader span, sureness, speed, and the reduction of vocalization. The second gave specific instruction in word recognition, in adapting reading to its purpose, and in increasing eye-voice span. The results demonstrated the possibility of improving adult reading, but showed greatest gain for the youngest subjects.

Other Photography

Normative studies (992, 1022, 1029) have continued to use motion picture photography for recording infants' spontaneous behavior and reactions to experimental situations. Gardner (1008) used a motion picture camera and accessory apparatus to photograph the pupillary reflex during different types of stimulation and during stuttering. Posture silhouettes obtained with an Eastman 2A camera suggested to Crook (999) a scale for rating antero-posterior posture. Jones (1021) listed front-side-rear photographs obtained with a specially built camera as an important feature of the California adolescent growth study.

Electro-Encephalography

In 1938 Jensen (1019) summarized eighty-eight investigations reported since 1848 relating to electrical activity of the nervous system and described apparatus and recording technics. Additional contributions include studies by Cruikshank (1001) of the effects of visual stimulation on brain potentials, by Martinson (1030) of brain potentials during mental blocking, by Travis and Hall (1047) of the effects of visual after-sensations upon brain potentials, and a comparison by Raney (1034) of the lateral dominance and brain potentials of identical twins. Lindsley (1026, 1027) and Smith (1039) identified brain potential characteristics of infants, children, and adults. Of particular interest to educational psychology is a preliminary study by Knott (1024) of brain potentials during oral and silent reading; potentials appeared most stable during minimum stimulation, less stable during propositional speech, still less stable during silent reading, and least stable during a combination of reading and speech.

Tachistoscope Studies

Laboratory equipment was used for testing and teaching by Bean (995), who mounted a twin tachistoscope on a piano in order to study span of perception in reading music; he found a low positive correlation between years of music training and perceptual span, and demonstrated an effective technic for changing part readers into pattern readers. Swanson (1041) used a tachistoscope and sound recording in identifying the common elements in poor silent and poor oral reading. Eames (1004) reported speed of perception slower with poor readers than normal readers, and noted some increase in speed with treatment of visual difficulties and training. A modified form of the Dodge mirror tachistoscope was used by Keller (1023) in a study of ocular dominance and range of visual apprehension; the findings were interpreted as indicating a functional relationship between retinal halves whose neural connections terminate in the same hemisphere. Similar apparatus was used by Crosland (1000), who reported that superior readers excel poor readers in the left visual field and inferior readers excel superior readers in the right visual field; kinship was inferred between left eye dominance and effective reading.

Studies of Visual Factors and Reading

Variable results obtained with entering school pupils by Gates and Bond (1010) from the Betts Ready To Read Tests and Telebinocular were attributed at least in part to the inexperience of young pupils in taking tests; the frequency of indicated difficulties suggested the desirability of thoroughgoing visual examination for all entering children. Using the same tests, with 850 pupils from kindergarten to Grade VI, Wagner (1048) was able to show a definite and sometimes statistically significant maturation of certain

visual factors with age and a positive relationship between normal functioning and success in reading.

Farris (1006) concluded from a study of seventh-grade pupils that, barring myopia, hyperopia, and strabismus, visual defects have little effect on progress in reading. Witty and Kopel (1050) summarized a number of important studies and concluded that poor readers were not characterized by a greater incidence of visual defects and anomalies than good readers.

In a study using the Ophthamo-Eikonometer, Dearborn and Anderson (1002) found that reading disability was more directly related to aniseikonia at the near than at the far point, that aniseikonia is one factor in 50 percent of extreme cases of reading disability, and that it probably differentiates good and poor readers better than other eye defects. Imus, Rothney, and Bear (1018) concluded that when Dartmouth freshmen were grouped according to ocular defects there were no significant differences in performance or gains in reading test results, eye movement records, or academic standing, and that correction of ocular defects did not guarantee immediate improvement.

Miscellaneous Technics and Apparatus

Severe space limitations forbid more than brief mention of selected samples of other laboratory studies relating to educational problems. Berrien (996), using a digitalgraph, concluded that an atypical composite index derived from finger oscillations of normal college students is evidence of emotion, but a typical index does not guarantee absence of emotion. Limitations of the electro dermal technic for the measurement of attitudes were pointed out by Chant and Salter (998), who noted spontaneous deflections from coughs, sighs, and the like, and who found that galvanic responses may be occasioned by the difficulty of making decisions rather than by the nature of the opinion. Among the audiometer studies was one by Hall (1012) indicating that for college freshmen auditory acuity is not a differentiating factor between normal and defective speaking. Other laboratory studies have correlated metabolism and intelligence (1016), muscular tension and learning (46), and hand and eye dominance in relation to reading (1009, 1049).

Growth studies summarized in a recent number of the *Review of Educational Research* (1031) included descriptions of such laboratory instruments and devices as the anthropometric board, improved sliding calipers, the cephalo dentometer, and the craniometric slide compass. Johnson and Evans (1020) described apparatus for measuring visual accommodation from light to darkness. A chronoscope with ten pointers for group studies of choice, serial response, and the like, was devised by Hertel and Dunford (1014). Schlosberg (1036) calibrated nine reaction time instruments of seven different types and found errors so general as to indicate that for careful research all chronoscopes should be checked.

CHAPTER XVIII

Organized Research in Education: Foundations, Commissions, and Committees¹

CARTER V. GOOD

IT HAS SEEMED APPROPRIATE in a number dealing with educational research as a process to include some description of organized provisions for research. In view of the fact that these provisions include both national and local agencies in the form of official, voluntary professional, and lay groups, and in view of the extensiveness of the activity, it has seemed best to treat the subject in two chapters. The present chapter will deal with foundations which have supported educational research, with the American Council on Education which is essentially a large research commission, and other commissions and deliberative committees. The chapter which follows this will deal with research bureaus and departments in national, state, and local organizations.

No previous issue of the *Review* has dealt with this topic specifically, so that a definite time limit for the earliest material to be included cannot readily be set. The majority of the references cited however are of recent date. The treatment has had to be made sketchy to keep it within reasonable limits; in general, individual publications of the different organizations have not been cited, but only summarizing treatments which contain descriptions of these works. Where there were no such summarizing treatments, no reference for an organization may appear in the bibliography.

Philanthropic Foundations

Organized research, on a national as well as an international basis, owes a large debt to the philanthropic foundations. Educational and social inquiry has been promoted through endowments for higher institutions, fellowships, exchange lectureships, subsidies granted to investigators, and through the studies and publications of the foundations themselves.

An especially comprehensive treatment by Hollis (1073) of foundations in relation to higher education considered the foundation as a social institution in terms of historical development, policies, and organization; and described its activities for higher education in the areas of defining the college, disseminating information, student and faculty welfare, endowment and capital outlay, professional education, nonprofessional education, and distribution of grants. The conclusion was reached that higher education has received approximately \$680,000,000 with an emphasis directed increasingly toward social and cultural ideas, and toward adaptations to a rapidly changing civilization. While recognizing that frequently

¹Bibliography for this chapter begins on page 633.

the foundations have lacked social awareness and outstanding leadership, have failed to anticipate educational trends, and have been opportunistic in seeking the improvement of higher education, Hollis suggested that with increasingly large and diversified sources of revenue the foundations may do even more for higher education in the second than in the first third of the twentieth century.

Rio's congratulatory account (1092) of the work of thirteen foundations proposed to analyze the effects of the depression on the grants awarded, although the problems discussed were not closely related to this purpose. Lindeman (1079) presented a statistical summary of the grants of a hundred foundations for the decade 1921-30, and was particularly critical of the foundation as a cultural agent, and of donors and trustees. Keppel described the foundation as a social institution (1075) and analyzed the relationship between philanthropy and learning (1076). Coffman's study (1066) was a sociological treatment of a decade of activity, 1921-30, on the part of 55 foundations, 20 community trusts, and 32 child welfare organizations, in the area of child welfare. Leavell (1078) included consideration of the foundation as a part of the total philanthropic aid to Negro education. Sears (1093) reviewed the various types of philanthropy in American colleges, beginning in the early Colonial period. Gee's questionnaire survey (1070) of the organization of social science research in higher education dealt briefly with the aid received from foundations, while Ogg (1089) included more detailed descriptions of the part played by foundations, endowments, and fellowships in promoting the social science research of higher institutions, research organizations, and learned societies.

A list of the foundations, and of their locations and officers, is available in the annual educational directory of the United States Office of Education (1098). The annual reports of these organizations include accounts of the publications, projects, and activities completed during the preceding year, those in progress, and those planned for the future. The "Department of Research News" in the *Journal of Educational Research* at frequent intervals reviews the activities of selected foundations, including the major projects to which research grants have been awarded.

American Council on Education

A very active organization in the sponsorship and supervision of large-scale, cooperative studies, and in disbursing research grants from the foundations, is the American Council on Education. One of the chief functions of the Council is deliberative—to look critically over the whole educational scene to discover those issues and procedures which merit study. In addition to the functions of research and deliberation, the Council provides continuing services in publication, consultation, and participation in national organizations and meetings which formulate educational policy.

The Council publishes annually a booklet (1054) portraying its history, organization, functions, activities, membership, and publications, including the names of its committees and commissions.

The Council's Committee on Problems and Plans in Education chooses the problems to be studied and preserves a balanced program of activity. Subcommittees of 1939-40 are concerned with general education, the master's degree, business education, professional education, educational research, rural social studies, educational journalism, occupational training and vocational adjustment, and responsibility and relations of governing boards. The major projects and activities of the Council during 1939-40 are: American Youth Commission, Financial Advisory Service, Committee on Motion Pictures in Education, Commission on Teacher Education, Cooperative Study of Secondary School Standards, Committee on Measurement and Guidance, Committee on Student Personnel Work, Committee on Cooperative Study in General Education, Committee on Implementation of Studies in Secondary Education, Committee on Modern Languages, Advisory Committee to the National Resources Planning Board, Committee on Government and Educational Finance, and Committee on School Plant Research. A number of these projects will be described briefly in the following sections characterizing the research work of selected national commissions and committees. The numerous activities and projects of the American Council on Education are reported at frequent intervals in the Department of Research News of the *Journal of Educational Research*, and in the Council's journal, *Educational Record*.

Research Commissions and Deliberative Committees

The decade of the 1920's marks the beginning of a period of large-scale cooperative investigation, usually under the direction of national commissions or committees. This movement has been accelerated during the decade of the 1930's. Among the earlier surveys or studies, in addition to those sponsored by the United States Office of Education and the Research Division of the National Education Association (which are reported in the following chapter), are those dealing with educational finance (1068), teacher training (1063), adult education (1058), child health and protection (1101), motion pictures and youth (1064), character education (1065), genius (1095), social trends (1090), modern foreign languages (1072, 1096), and Latin (1051, 1080). Limitations of space do not permit a description of these earlier studies. Only brief characterizations may be given of selected projects completed or in progress during the period 1937-39. Fuller descriptions are available in the following works (1059, 1060, 1061, 1062, 1071, 1082, 1087), and at frequent intervals appear in the "Department of Research News," *Journal of Educational Research*; certain of the subsequent summary statements have been adapted from such sources. It will be recognized that certain of the reports are of

the deliberative, evaluative type rather than of a strictly research character, but they nevertheless possess major significance for crucial issues and problems in education.

The Committee on the Orientation of Secondary Education presented to the Department of Secondary-School Principals, National Education Association, its two reports on the issues (1057) and functions (1056) of secondary education. The ten functions were discussed at length and approved by the committee in its sessions extending over three years, and each function was assigned to an individual member for development. A Planning Committee developed a nationwide organization of discussion groups to analyze the reports of the orientation committee and to consider other important problems in secondary education.

The Commission on Teacher Education of the American Council on Education, formed in 1938 for a five-year period, launched during 1939 a "Cooperative Study of Teacher Education" involving twenty higher institutions and fourteen school systems and groups of school systems (1053). The major purposes of this study are to encourage a rapid translation into practice of generally accepted knowledge in teacher education and to stimulate experimentation, broadly conceived, with programs of teacher education and teacher growth in service. It has been assumed that these two purposes would be best served by working closely at the outset with a limited number of institutions and school systems.

The Committee on Revision of Standards of the North Central Association (1102) reported its findings in seven volumes, completing its program of publication during 1937. This project for the revision of accrediting procedures had its inception in the general dissatisfaction that had become increasingly manifest with the operation of fixed, quantitative standards. The general plan of the investigation involved an analysis of all the information that could be considered as having any logical bearing on the quality of an institution.

After six years of intensive work the Cooperative Study of Secondary School Standards (1067), under the auspices of the six regional accrediting agencies and the American Council on Education, has completed its work. It now has ready a body of materials and procedures for evaluation of secondary schools believed to be more valid, flexible, and stimulating to improvement than any available in the past. In the development and refinement of these materials, they were first carefully tested in two hundred secondary schools of various sizes and types in different parts of the country. As a result of this tryout the materials were extensively revised and published as "1938 editions" and again tested in ninety additional schools. During the spring and summer of 1939 they were further revised and rewritten. The "1940 editions" represent the best judgment and experience of the Cooperative Study. It is expected that further revisions will not be made for at least five years.

As its program of investigation nears the date of completion (1940), the reports and studies of the American Youth Commission of the American Council on Education have been appearing with increasing frequency. Its projects and special inquiries are so numerous and varied as to preclude separate mention here, but may be identified by means of a booklet distributed by the Commission (1052).

The Progressive Education Association has Commissions in three significant areas (1091). The Commission on the Relation of School and College (eight-year study) expects to complete its work in 1941. The period in which the Commission on the Secondary School Curriculum was to work ended on July 1, 1939. Consequently this Commission is engaged in sending to the publishers reports of its various committees. The general report, *Reorganizing Secondary Education* (1096), is already in print. This attempted to state the fundamental point of view that has permeated the work of the Curriculum Commission and its committees, and included a list of the reports of special committees. The Commission on Human Relations has been engaged in a series of projects to provide materials on personality and culture, the family, understanding human behavior, literature and human relations, life and growth, adolescents and parents, and motion pictures. Some of these materials have already appeared in print.

The Advisory Committee on Education has completed publication of its series of nineteen staff studies, on which the report to the Congress in February 1938 was based. These staff studies are listed in the general report (1097). Legislation based on the recommendations of the Committee has been under consideration by the Congress.

The Educational Policies Commission of the National Education Association and the American Association of School Administrators has now published three fundamental interpretations of the relationship which public education bears to our national life. Created in November 1935, to define guiding policies for American education, the Commission published its first pronouncement, *The Unique Function of Education in American Democracy* (1086), a little more than a year later. Since then it has elaborated the concepts of this initial document into two further statements entitled *The Purposes of Education in American Democracy* (1083) and *The Structure and Administration of Education in American Democracy* (1085). Descriptions of the current projects and activities of the Commission are reported bimonthly in a bulletin, *Educational Policy*.

The Social Science Research Council published a series of thirteen research monographs concerned with as many social problems (including education) in relation to the depression. Each author sought to examine critically the literature on the impact of the depression in his field for the purpose of: (a) locating existing data and interpretations already well established, (b) discovering serious inadequacies in information, and (c) formulating research problems feasible for study. The monographs dealt

with the following topics in relation to the depression: crime, education, the family, internal migration, minority peoples, reading habits, recreation, religion, rural life, social aspects of consumption, social aspects of health, social aspects of relief policies, and social work. The monograph on education (1084) prepared by the Educational Policies Commission dealt with problems in the areas of: historical and comparative education, theory and philosophy, student personnel, program of instruction, staff personnel, organization and administration, finance and business administration, and professional and scientific activities.

The sixteen volumes, including the summary report (1055), of the Commission on the Social Studies of the American Historical Association covered a wide range of problems—the public interest, administrative policy, curriculum, method, measurement, teacher personnel, and the like. The contribution of this series of reports should not be minimized by criticisms which have been offered, to the effect that it: (a) advocates indoctrination, (b) undermines the science of education, (c) imposes a frame of reference upon the teacher, (d) exceeds its authority in studying the administration of education, (e) fails to formulate a curriculum in the social studies, and (f) presents ideas impossible of realization.

The International Examinations Inquiry is still under way, with a few reports yet to be completed in England and the Scandinavian countries before a final summary volume can be prepared. The reports issued in the United States dealt with the several international conferences on examinations (1081) and with examinations and their substitutes (1074).

The Carnegie Foundation for the Advancement of Teaching (1077) issued a partial report of a ten-year project in the state of Pennsylvania, involving the examination of 26,000 high-school seniors and the testing of students in nearly fifty Pennsylvania colleges. The chief interest of the report centers on the results of an eight-hour examination in the main aspects of a general education. This was given to high-school seniors, college sophomores, and college seniors.

The Regents' Inquiry into the Character and Cost of Public Education in the State of New York resulted in eleven volumes, including the general summary report (1088). The problems treated embrace educational finance, school district organization, evaluation of the elementary and secondary schools, adult and higher education, motion pictures and radio, teaching personnel and teacher training, federal aid to the state, the state education department, vocational education, school health, community relations, and civic education.

In a few instances yearbooks represent the outcome of a planned program of research; as a rule they report the deliberations of a commission or evaluative treatments of problems in a particular area. Deliberative, evaluative discussions possess real value by way of analyzing trends

and identifying issues, even though there may be numerous gaps in the research on which the conclusions are based.

The National Society for the Study of Education contributed a long line of distinguished yearbooks, in many instances based on carefully conducted investigational programs. A booklet (1099) issued by the Society in 1926 commemorated a quarter of a century of service to the cause of education; it described the organization and growth of the Society, its meetings, and the yearbooks. (Each yearbook also includes a list of the earlier volumes in the series.) Whipple (1100) more recently contributed a chapter which analyzes the 36 yearbooks (67 volumes) of the Society published from 1902 to 1936, to reveal the kinds of problems studied and the methods of attack.

Other organizations which issue useful yearbooks include: American Association of School Administrators, Department of Classroom Teachers, Department of Elementary School Principals, Department of Rural Education, Department of Supervisors and Directors of Instruction, John Dewey Society, National Council for the Social Studies, National Council of Teachers of Mathematics, and National Society of College Teachers of Education. As a rule the current yearbook of an organization lists the titles of earlier volumes in the series. Descriptions of current and projected yearbooks are reported at intervals in the "Department of Research News" of the *Journal of Educational Research*.

Selle (1094) described in some detail the activities and publications of the numerous departments, commissions, and committees of the National Education Association. (The work of the Research Division of the National Education Association is treated in the following chapter.)

It is surprising in a decade of financial pressure that so many large educational projects have been organized and successfully financed. A possible explanation may be found in the suggestion that philanthropic foundations, professional organizations, educational institutions, and individual workers in a time of educational and social maladjustment may recognize the urgent need for cooperative attack on current issues (1071). Such a coordinated approach does not preclude the exercise of initiative and ingenuity in individual problem solving, but emphasizes the fact that many of the problems of the social sciences are so vast and complex as to yield to nothing less than a program of research, of which a number of individual studies may be a part.

CHAPTER XIX

Organized Research in Education: National, State, City, and University Bureaus of Research¹

DOUGLAS E. SCATES

THIS CHAPTER CONTINUES the discussion of organized research agencies begun in the preceding chapter and deals with departments or bureaus of research. The treatment is restricted to materials that are available in printed or mimeographed form, and does not itself represent a survey of the agencies. It may omit mention of a number of actual agencies because published accounts of their work have not been found. Owing to the large amount of scattered material the present treatise can be little more than a guide to the literature—one step in the direction of a systematic study of existing research agencies and their history, which is badly needed.

United States Office of Education

The Office was established in 1867 primarily to collect information. In 1933 the vocational education division was established to take over the functions and personnel of the Federal Board for Vocational Education. On July 1, 1939, the Office was transferred from the Department of the Interior to the Federal Security Agency. The staff of the Office in 1937 consisted of ninety persons in the general division and eighty-six in the vocational education division. Present services of the Office "are mainly of three types: (a) research and informational; (b) advisory and consultative; and (c) promotional" (1106:48). In his recent review of the history, personnel, and activities of the Office, Judd (1106) commented: "The educational statistics of the United States are more comprehensive than those of other countries and on the whole more usable." "The Office of Education has produced an enormous amount of research material of the highest value to the American educational system and to the American public" (1106:17, 70). Including the vocational education division the Office has conducted 361 surveys, 47 of which have been nationwide; these survey activities are treated in some detail (1106:24-34, 92-93, 115-17). Other activities are outlined in Chapters II, III, and Appendixes A and B of Judd's report.

The most recent treatment is a short one by the Educational Policies Commission (1107) which outlined the history and organization of the Office and gives a picture of its current activities, including new projects financed from emergency relief funds. A very brief but recent statement was given by the *Phi Delta Kappan* (1121); Chapman (1135:108-11, 135-38) and Monroe and others (1237:66-67) also referred to it. Several descriptive statements have been prepared and issued by the Office itself or by members of its staff. A pictorial and graphic presentation of the work was published

¹ Bibliography for this chapter begins on page 635.

in 1938 (1118). A brochure giving facts on the origin, history, organization, activities, and recent publications was issued in 1935; a revision is in press (1116). Segel (1109), in 1936, and Cooper (1104), in 1933, issued informative statements. In 1923 the Brookings Institution (1110) devoted one of its *Service Monographs* of the United States government to a description of the Bureau of Education—which it was called prior to 1929. Some 60 pages of the report deal with history and 40 pages with activities. Organization is treated briefly. An appendix of 50 pages cites laws, expenditures, publications for 1920-21, and a bibliography of works about the Bureau. Certain reorganizations in functions and in personnel have taken place since this report was prepared.

For recent and current studies the following sources may be consulted. The programs of twelve national committees and surveys were described in 1934 (1108). The annual reports of the Commissioner of Education contain much information; until 1918 they contained statistical information which is now issued as Biennial Surveys of Education. Since 1933 these reports appear only in the Reports of the Secretary of the Interior. *School Life*, the monthly publication of the Office of Education, carries frequent reports of projects under way. The "Department of Research News and Communications" which appears monthly in the *Journal of Educational Research* contains numerous items on the work of the Office (1105). Other references may be found in the *Education Index* under the head "United States—Office of Education," and in the *Readers' Guide to Periodical Literature* under the head "United States—Education, Office of." These last four sources include both publications of the Office and articles written about the Office and about its publications. The quarterly *Journal of the American Statistical Association* has carried reports on statistical projects of the Office in its "Statistical News and Notes" since June 1935.

The publications of the Office are listed systematically, from the establishment of the Bureau in 1867 to 1910 (1113), and from 1910 to 1936 (1115). These bulletins are kept up to date by cumulative supplementary lists issued annually, the latest for the Office in general being 1930-39 (1119) and for the vocational education division, 1939 (1120). The 1910-36 list (1115) contained the first complete list of the publications of the Federal Board for Vocational Education (which began in 1917), and is in general an unusually valuable guide. It listed thirty-eight different series of publications for the Office and twelve more for the vocational division; it listed the annual reports of the Commissioner since 1910; earlier ones are found in *Index to the Reports of the Commissioner of Education, 1867-1907* (1111).

There are also other sources of information on the publications of the Office of Education. Certain overlapping lists of publications are useful when the two main lists (1113, 1115) are not available: from 1867 to 1907 (1112); from 1906 to 1922 (1124); and from 1906 to 1927 (1123). The last two list only the bulletin series, not other publications. There are two

lists of *Publications Available*—one in 1912 (1114) and one in 1930 (1117). Annual price lists of available materials may be obtained from the Government Printing Office (List No. 31, regardless of year); these arrange publications only by topic—not by author, class, or serial number. When all of these sources fail, there is the *Education Index* back to 1929 and the *Readers' Guide* back to 1906, and the general indexes of government publications, as the *Monthly Catalogue of United States Public Documents*, back to 1895, which is cumulated (back to 1896) into the *Document Catalogue*. There are also other governmental indexes. Witmer and Miller (1122) prepared a helpful analysis of the United States Office publications up to 1933; this material was extended somewhat and reprinted by Alexander (1103) in 1935. Their work has been largely superseded by the bulletin published in 1937 (1115) but their explanatory comments are still of value and some of their classifications are unique and helpful. The role of the Office in cooperative research is treated later under that head.

National Education Association—Research Division

While the history of the National Education Association goes back to 1857 the Research Division dates from 1922. The regular staff has increased from three workers at the beginning to twenty-one persons in 1938-39. The Research Division is the general research agency for the Association; it also aids directly a number of the separate departments and the special committees in carrying on their research and preparing their yearbooks or other reports; it assists in the work of the Educational Research Service—an informational and research service primarily for school administrators; and at the present time it is contributing to the work of the Educational Policies Commission through permitting its director to serve as the productive secretary of the Commission.

The activities of the Research Division (1127) have been described as falling in four areas of work: (a) research, (b) informational, (c) editorial and consultative, and (d) administrative. While the Division produces a noteworthy amount of research of its own, it also serves research in a broad way by cooperating with a number of other agencies connected with the National Education Association in planning, collecting, writing, editing, and disseminating information on problems in their own fields of interest. A significant part of the energies of the Research Division are devoted to making research materials available to the school administrator and school teacher working in the field. It is reported as caring for about 5,000 individual inquiries per year, sent "by students, classroom teachers, parents, board members, principals, and superintendents." Two descriptions of the work of the Division were available in 1939 (1127, 1128); one was prepared in 1932 (1130); accounts by Selle (1132) in 1932, and by Ogg (1131) and Chapman (1135:111-12, 138-40) in 1928 and 1927 represent statements by writers outside the organization. The activities of the Division can be followed in detail in its annual reports (1129).

The principal publication of the Research Division is the *Research Bulletin*, issued five times a year beginning in 1923; the Division also prepares the material for the *Educational Research Service Circulars*, the biennial *Special Salary Tabulations*, and one or more pages in the monthly *Journal* of the N.E.A. The productions are described in some of the references cited; Alexander (1125) in his chapter on the publications of the entire National Education Association gives a complete list of the *Research Bulletins*. The *Education Index*, under the head "National Education Association—Research Division," lists all the publications issued directly by the Division and articles written by the Division or its staff but published in other journals. The *Readers' Guide* carries the head "National Education Association." One or two notes have appeared each year among the news items of the *Journal of Educational Research* (1126).

Research in State Departments of Education

Systematic discussions, directories, and lists—Chapman (1125) in his pioneer study of organized research in 1927 listed five state research bureaus and treated them along with other research bureaus of various types. The following year he reported on state research bureaus alone, listing fifteen of them (1134). The United States Office of Education in its *Educational Directory* for 1932 (1153) lists the names of research departments and directors for twenty-seven states and Washington, D. C. In subsequent years the names have not been printed in a separate list but have been included in the list of Principal State School Officers. Two of the staff studies for the Advisory Committee on Education (1137, 1142) make brief comments on research work in state departments. Lists of studies made by research bureaus of state departments have been prepared for 1929 to 1936 (with the exception of 1933-34) by the National Education Association (1147) and by the Office of Education (1144, 1155).

The work of individual bureaus—The Division of Research of the State Education Department, of the University of the State of New York, has been most prominent of all the research bureaus in the literature. We can only refer here to several articles (1138, 1139, 1140, 1146, 1148, 1149, 1150, 1151). It is significant that the organization of the state department as modified in 1937 gives the research work the status of a division with an assistant commissioner of its own, responsible directly to the commissioner and not through an associate commissioner (1149). The Bureau of Statistical Services is subordinate to the Research Division. The function of examinations and testing is in a separate division connected with instruction. Such an organization appears to give the function of research a position which recognizes its potential service. It also presages the time when more or less routine testing will generally be distinguished from research in the large instead of frequently being regarded as synonymous with it. The history of the division and plans for the future are given in (1151).

Wood and others (1154) issued annual reports on scholarship testing and research in Ohio; for references describing statewide testing programs in a number of states see (1182:302-304). Mikesell (1145) described other official research in Ohio. For further reports on the work in individual states, one should consult the topic "Departments of Education, State" in the *Education Index*; also articles listed by state name (1141). News items in the *Journal of Educational Research* (1143) cover work in eighteen states. We may note also the work of related departments, such as the California Bureau of Juvenile Research, and the New Jersey Rehabilitation Commission.

Stimulation of field research—One of the functions of a full-fledged state department program is to stimulate research by others throughout the state. Articles have been written concerning such work by Berning (1133), Cocking (1136), and Coxe (1138, 1140). One device for stimulating research is the publication of a list of problems needing study in the state (1148, 1152).

State Education Associations and Research

Educational associations are known to do a good deal of publishing but it is somewhat difficult to find a significant amount of published research by them. Some of their research is done in cooperation with state departments or with state universities and does not appear directly under their name. Much of their work is published only in mimeographed form, or in state journals, and is not readily available.

A number of states have active research departments in the state organization. Ohio has a report on its director (1160, 1285), and an annual list of studies by its research department members (1162). Pennsylvania also has a research organization and has published some descriptions (1157, 1163). The Nebraska department has been active since its establishment in 1936 (1161). The Illinois Education Association has published an occasional bulletin (1158). The New York educators are split into a number of associations, several of which cooperate with the state department in research and some of which occasionally publish a study of their own. In Texas the research department of the state teachers association has published some studies (1164) and a Commission on Coordination in Education consisting of public school, university, and state department representatives has published a number of studies (1159). Other references will be found in *Education Index* under the above state names. Also, several states have related societies such as the California Association for Adult Education and the Michigan Educational Planning Commission, which do research.

Lists of studies undertaken or completed by state educational associations have been prepared by the National Education Association (1147) and by the United States Office of Education (1144, 1155). The names of directors of research in six states were given in 1932 (1153) but have not been published in the *Educational Directory* since.

City School Research Bureaus

Directories and lists of studies—The first list of city research bureaus known is that of Nifenecker (1200) in 1918 which contained eighteen cities. He noted the difficulty, since encountered by every worker who has attempted to list or study research bureaus, in determining when a research bureau really could be said to exist. The United States Office of Education has issued several publications listing the city research bureaus in 1923 (1170, 1178), 1924 (1195), and 1931 (1224). Chapman listed 63 in 1927 (1135: 219-20). A list appeared in the *Educational Directory* of the Office of Education in 1931 and in 1932 (1153) and research directors have subsequently been indicated by code in the annual directories—now in Part II, "City School Officers." Lists of studies undertaken and completed by city research departments have been prepared by the National Education Association covering 1927-29 (1197, 1198), and by the Office of Education covering 1929-36 (1184, 1223), with the exception of 1933-34.

Survey studies of organization, functions, and facilities—While Nifenecker made a brief summary in 1918 (1200) the pioneer study and report of functions appears to be that of Martens in 1924 (1195). This was followed in 1931 by a second leaflet prepared by Wright (1224). The most extended and intimate picture of the conditions surrounding the establishment of the earlier bureaus and the functions they were expected to discharge was given by Chapman (1135). While the study was based in part upon a questionnaire it presents a detailed story that goes well beyond the type of information that questionnaires alone will reveal. Chapman attributed the creation of bureaus to several large emphases: (a) the school efficiency movement—the idea that "the administration of public education could profit by utilizing some of the methods developed by industry for improving efficiency and eliminating waste," and that there should be "within the school system an organization to administer the survey technics and furnish the superintendent with an accurate evaluation of the status of any phase of the schools' activities" (p. 39); (b) the adjustment movement—the conviction that "the school has been made responsible for ascertaining the obstacles to learning, with the purpose of bringing about their prevention or removal" and that "one of the fundamental problems of educational research is the devising of means for effecting the best possible adjustment of child and curriculum" (p. 54); (c) the measurement movement—the "need for setting up machinery to administer standardized tests, to construct new tests, to promote the use of tests, and to provide training in technics necessary for the attainment of that end" (p. 70); and (d) what might be called the objective movement—the desire for facts, such as those produced in surveys, "encouraged the creation of bureaus for gathering and organizing educational data" and the provision for "a central office to which might be referred all inquiries for information about the school system or about educational practice in other cities. . . . During a period of three

years, ending in 1924, the New York Bureau answered more than one hundred thousand queries" (p. 89). Other factors in the organization of bureaus were the desire for "coordinating and promoting the research activities of principals, teachers, and other school people" (p. 99) and the need for studying problems of administration, teaching, curriculum, and progress of pupils.

The foregoing statements indicate the diversity of purposes that have led to the establishment of city research bureaus. It should be clear that it is necessary to divide bureaus into several classes before making general statements about them. The lack of homogeneity of organizations that are generally known as research bureaus is one of their outstanding characteristics. There is little value in reporting certain findings in terms of averages—such as "the average amount spent per year on the purchase of tests," when some bureaus do no testing whatever and others do little else.

Other studies which have reported on the activities and facilities of city research bureaus are: Herbst (1185, 1186) in 1930, Kaler (1192) and Hull and Maynard (1190) in 1931, Brewton (1171) in 1936, and Witsky (1222) in 1938. Carr (1175) reported on salaries for 1935. Scates (1207) made a questionnaire study of the "career aspects" of the city school research bureau as viewed by the directors.

Zeigel (1225) made an extensive study of research in secondary schools as part of the National Survey of Secondary Education in 1932. He included returns from seventy city research bureaus. He concluded that "the researches made by city bureaus are of a relatively simple fact-finding nature; they are studies which require but few technical methods or statistical procedures in order to interpret and present the data" (p. 64). "If bureaus of research in city systems are to lead the way to a sounder educational program, they will find it necessary to place emphasis on fundamental problems of educational practice rather than on the mere compilation and publication of facts and statistics."

The results which Zeigel and other writers hope for will come when the profession generally recognizes that a competent research director is something more than a young doctor of philosophy having statistical training. If the research director is actually to occupy a place of broad responsibility he must be a man fitted to carry that responsibility. He must have an educational training and experience and an understanding of educational problems and processes that will be respected by practical administrators and teachers; and he must conceive of research in its broad terms and not primarily as a set of mechanical technics—sleight of hand tricks by which he can work wonders. He will not be concerned solely with objective facts apart from psychological facts, or with theoretical criteria to the exclusion of widely held practical criteria. He should be as interested in incorporating justified conclusions into practice as he is in determining these conclusions; and he will be more concerned about carrying the thinking of others along with his own than in bypassing theirs. He must exhibit the same qualities

as any able administrator: understanding, orientation, judgment, sense of values, personal leadership. When school superintendents come to expect this sort of director and when research workers prepare themselves for this sort of opportunity the desired progress in school research bureaus will follow.

Descriptions and reports of individual bureaus—A number of research workers have published descriptions of the work conducted by their bureaus. Usually these are more intimate and full than the information concerned in survey studies. More such descriptions are to be desired. The bureaus covered are: Baltimore, by Stenquist (1212, 1213); New York (1173, 1200, 1204); Denver (1179); Sacramento, by Bursch (1174); and East St. Louis, by Osborne (1201). The work at Oakland was reported by the Department of Superintendence as an illustration (1196); research work at Winnetka has also been described (1169, 1218). Other writers with direct experience in city research bureaus have prepared more general statements on the functions and values of research: Howell (1188), Hughes (1189), Sackett (1205), and Theisen (1214, 1215).

Reports of the work of city research bureaus are frequently included as sections of the superintendent's report for their city. A few research bureaus publish reports of their work: Philadelphia (1203) and Los Angeles (1194); a number of others issue mimeographed reports. New York has published the findings of the research bureau as one volume of the superintendent's report (1199). A few research bureaus have been treated in city school surveys (1168, 1202, 1217). News items concerning the work of twenty-eight research bureaus have been reported in the *Journal of Educational Research* (1183). Printed and mimeographed publications of research bureaus will be found under the names of sixteen different cities in the *Education Index* (1181).

Publicity and research work—Three writers have treated the service that the research bureau can render the school system in connection with the public relations program: Bain (1167), Scates (1206, 1208), and Tupper (1216).

Organization of bureaus—Several writers have dealt primarily with the external and internal organization of research bureaus—with their position in the total administrative scheme of the school system, and with the internal working arrangements of the bureau: Keyworth (1193), Sears (1210), and Weidemann (1220). A committee of the American Educational Research Association (1211) described the desirable organization and functions of research bureaus. Other writers have dealt with the subject incidentally. Organization for state bureaus is suggested by New York (1149).

Other statements on research bureaus—Articles giving the writer's convictions on the place, functions, and values of city school research are numerous. Space limits forbid a summarization; a few selected articles are cited for reading: (1166, 1172, 1176, 1180, 1187, 1191, 1219, 1220, 1221,

1328). Primarily as sources of earlier references one may wish to consult Cubberley (1177), Barr and Burton (1169), and Good, Barr, and Scates (1182). Additional references for the past and for the future will be found in the *Education Index* under the topics "Research Bureaus" and "Research Workers"; and in the Office of Education's annual *Bibliography of Research Studies in Education* under the heading "Research Bureaus" in the subject index.

Research Bureaus in Universities and Colleges

Most of the research bureaus in institutions of higher learning are better known by their works than by descriptions of their work. They have been organized for a number of different purposes: some study the administrative and instructional work of their own institution; some study field problems—usually those in educational systems of the same state; some study theoretical problems in general; some are devoted to testing throughout the state; some are devoted to child study; some have a variety of purposes.

The earliest known list of research bureaus in universities is that by Baldwin and Smith in 1924 (1170); 22 institutions are included. The Office of Education *Directory* for 1932 (1153) contains 39 bureaus in universities and colleges and 25 bureaus (including six at Teachers College, Columbia University) at teachers colleges and normal schools. The listing or indicating of research directors in higher institutions has not been continued in these directories. For other sources of information we have recourse in the news items of the *Journal of Educational Research* (1235) where the activities of 26 different bureaus are reported, and in the *Education Index* (1232) where the publications of 22 research bureaus are listed under their own name following the name of their institution.

Chapman (1135: 23-38, 112-14) gave a detailed description of the establishing of a number of bureaus and is practically the only source of information on some of them. Oklahoma University is given credit for establishing the first research bureau in education in 1913 (1135, 1241); the Bureau of Cooperative Research was founded at Indiana University in 1914 (1241). Monroe (1237) described the founding of the bureau at the University of Illinois in 1918, and gave detailed information on the history and organization of the Institute of Educational Research at Teachers College, Columbia University, which was established in 1921, to include the division of (educational) psychology, the division of school experimentation (1226), and the division of field studies. The Institute of Practical Arts Research and the Child Development Institute were later inaugurated but discontinued; a curriculum laboratory and a guidance laboratory are now maintained. Notes on the work of the Institute will be found in many issues of the *Teachers College Record* and in the annual reports of the dean of Teachers College.

The Bureau of Educational Research at Ohio State University has published a number of annual reports (1227, 1228, 1229, 1230), one of which (1228) is notable as an evaluation of research activities. The last ten years of the work of the Iowa Child Welfare Research Station, which began in 1917, were described by Stoddard (1242) and a decade of research and service at Kansas, 1920-30, was described by O'Brien (1239). A number of writers have discussed university research bureaus in somewhat general terms, based on their experience with particular bureaus. Frasier and Whitney (1234), Whitney (1243), Flory (1233), Mort (1238), Griffith (1236), and Scroggs (1240).

Apart from published descriptions one feels constrained to mention a number of research bureaus and departments; for example, the child study laboratories at the universities of California, Chicago, Cincinnati, Iowa, Michigan, Minnesota, Toronto, and Yale; the division of surveys and field studies at the George Peabody College for Teachers; the curriculum laboratory at the same institution—which has issued a typed list of 47 curriculum laboratories in universities and public school systems, some half dozen of which are probably doing genuine research work in addition to or in lieu of immediate production; the statistical laboratory at the University of Chicago, which has issued a series of studies; and the bureau of educational research at the University of North Carolina, which is now sixteen years old. There are also the well-known testing departments of the University of Iowa and the Kansas State Teachers College at Emporia. It is also worth noting that 21 university presses are listed in the *Education Index* list of publishers; these represent one phase of research.

Other sources of information on organized university research include the official annual reports of the director or deans; the catalogs or announcements of the institutions; and the publication catalogs of the various university presses.

Unorganized Research in Colleges and Universities

While unorganized research does not fall within the scope of this treatment it is nevertheless true that institutions of higher learning may be regarded as organizations which in their totality exist in large part for the purpose of research. There is at least enough truth in this position to warrant a brief mention, in passing, of the contributions to research which emanate from these institutions.

The outstanding treatise on research in colleges and universities in the social sciences is that by Ogg (1259) in 1928. The work does not deal directly with education, but the general attitude toward research of the institutions which he describes applies to education as well as to other departments. Gee (1252) made a survey in 1934 which supplements that of Ogg, bringing parts of it up to that date. The advantages and shortcomings of research by college faculties were discussed by Spahr and

Swenson (1329) and the National Resources Committee (1326: 165-95). The latter pointed out eight ways in which faculty contributions are important and states that the research which is voluntarily undertaken by the faculty "properly originates in the scholarly curiosity of the staff members and must be largely free and independent" (p. 176).

Rosengarten (1262) reported on educational research in 45 institutions, with an emphasis upon New York University. Studebaker (1263) discussed the research contributions of land-grant colleges, and Kelly (1255) did the same for state universities. Upshall (1267) dealt with teachers colleges. Three writers—Ellis (1250, 1284), John (1254), and Sullenger (1264)—discussed research in urban universities. Ogan (1257, 1258) contributed an outstanding account of a college faculty working on its own problems. Dunbar (1249) and Wrenn (1271) also pointed out beneficial effects of research on the faculty. The Office of Education in 1931 published a bulletin on university problems (1266); since that time the literature dealing with research on higher education has expanded enormously. Baehne (1245) edited a book dealing with the applications of tabulating machine equipment in universities for both routine and research work.

For current sources on faculty research one should consult issues of *School and Society* and the *Journal of Higher Education*, the official publications of many institutions which list each year the research completed by their staff; the *Bibliography of Research Studies in Education*, issued annually by the Office of Education, and the *Education Index* (topic: "Research—colleges and universities," or other institutional level desired). Many articles will be found dealing with such matters as the function and value of research by the faculties, grants and funds for research at various institutions, opportunities for research, the equipment which is essential for research, problems of administering research, and the like.

Thesis research—It is unnecessary here to cite individual lists of theses or series of thesis abstracts since this material, scattered as it is, has already been well covered. Palfrey and Coleman (1260) in 1936 is the most comprehensive source but covers all fields. Monroe and Shores (1256) also in 1936 is the best source for education theses (topic: "Dissertations" and "Education, Serial Bibliographies"). Derring's treatment (1248) in 1933 was helpful; Good, Barr, and Scates (1182: 122-23, 152-53) cited general sources up to 1936; Alexander (1125: 157-58, 224-29) gives helpful and specific advice on material up to 1935. All these sources may be supplemented by current issues of the *Education Index* (topic: "Dissertations, Academic—Bibliography"), by issues of the *Bibliographic Index* (topic: "Dissertations, Academic"), and by the Office of Education annual *Bibliography of Research Studies in Education* (topic: "Research, Educational—Reports"). Witmer (1270) in 1932 and Heyl (1253) in 1939 have dealt with the sources of information about research which is in progress. Several theses have been devoted to the study and analysis of the technics and materials used in other theses (1246,

1247, 1265, 1269). Ernst (1251) and Raeder (1261) have written on the value of undergraduate theses as a research stimulus. Further material on theses and general university research is contained in the two following sections.

Cooperation and Coordination in Research

Educational research during the past ten years has included large-scale undertakings never before experienced (1286, 1314). The chief sponsors of these enterprises have been the Office of Education and the foundations and societies described in the preceding chapter. We must recognize also the great increase in bibliographical and summarizing services of recent years—the *Education Index*, the Office of Education Bibliographies, the National Education Association Research Division summaries, the works of such bibliographers as W. S. Monroe and C. V. Good, the *Review of Educational Research*, and others. There are definite and salutary tendencies to engage the energies of large numbers in attacks upon many problems, to integrate scattered attacks, and to make the total program of research more systematic, in addition to the general increase in the quantity of research studies.

Cooperation in research may be of several kinds, for several purposes. Since the Office of Education is without legal authority to require conformity, its enormous statistical studies are plagued by the idiosyncracies and individual volitions of the state departments, cities, and individual schools from which it seeks to obtain uniform data. In making a concerted attack upon the problem of uniformity in reporting, the Office has engaged in a significant type of leadership in a cooperative enterprise. Judd's report (1106: 22-24, 86-94, 97-103) referred to several types of cooperation and coordination in research which the Office has been able to engage in through the opportunities afforded by special funds. We may note the five nationwide surveys, the cooperative research in universities project, and the study of local units. These types of leadership and followership promise much for the advancement of education—if they can be continued. They appear to depend upon extraordinary income. Opportunities for national leadership were discussed by Cushman and Fox (1282), Cooper (1280), Chapman (1135: Chapter 13), and the Department of Superintendence (1196: 319-21).

Statewide cooperation has been frequently mentioned as one of the objectives of state department research bureaus (1138, 1148, 1279, 1285, 1292). These purposes were referred to earlier under the section on state departments of education. Statewide cooperation with university research was discussed by Ashbaugh (1275), Chapman (1135: 33: Chapter 4), and Crowley (1281), while a variety of forms of university research cooperation were presented by Ellis (1284), Kelly (1288), McGrath (1289), National Resources Committee (1326: 13-18, 53-58), and Rosen-garten (1262).

Cooperation in the study of secondary-school problems, sometimes involving the high-school principals and teachers, was written on by Bristow (1277), Davis (1283), Jessen (1287), O'Brien (1291), and Proctor (1293). An emphasis upon involving public school workers, whether elementary- or high-school, in research programs has been made by Ascher (1274), Barr and Burton (1169: 385-402), Brownell (1278), Chapman (1135: 101-105), and Toops (1294), as well as by a number of writers previously cited.

Monroe (1290) was one of the early workers to advocate cooperation in research (1911). A general survey of research in 1923 (1170) reported a certain amount of cooperative work. Good, Barr, and Scates (1182: 742-47) summarized various points of view and cite references to further literature.

Undoubtedly we need more large-scale research than we have yet seen; but the types of problems which can be solved by an army of workers following the directions of a few persons are limited. Unquestionably we need more planning in research than we have yet had; but planning must reckon with the interests and the drives of the individual worker. The long-run strength of research will continue to lie in the diversified centers where capable workers carry on individually or with a moderate following. In conceiving of an ideal program of research for the nation we must think of a balanced program having a certain proportion of large enterprises, a certain proportion of individual effort, and a large portion of work by moderate sized groups working in a relatively uncoordinated fashion. In seeking to work out such a program there is room for national, state, and city planning bodies to sense needs, formulate problems in terms of the needs, and direct attention to the formulations. Some kind of machinery which would facilitate voluntary cooperation by widely scattered groups with common interests should also be found. But any material degree of regimentation would be more regrettable than the present state. It is not correct to assume that all desirable research is of the large organization type, or that efficiency in our forward march requires that every separate study fit into some preassigned niche in an all-enveloping master plan.

Training for Research Work

Germane to all organized research is the matter of training workers to do research. Like other problems of instruction, this involves questions of objectives and of method. Statements on the nature of the work to be done and on the qualities and characteristics which are desirable in the research worker were made in particular by Buckingham (1298, 1299), Hoscic (1304), Scates (1306), Whitney (1315), Withers (1316, 1317), and the American Home Economics Association (1295). Studies reporting on the amount of training now possessed by directors of research include most of the surveys referred to in connection with city school research

bureaus. A survey of courses available for training workers was made by Tyler (1312); criticisms by research workers of the training they had received were also analyzed by Tyler (1313). Smith (1308) dealt with the growing demand for research workers.

The subject of training research workers, together with the pertinent literature up to 1936, was covered in a chapter of Good, Barr, and Scates (1182: 708-68), and for that reason comment will not be extended here. We may merely note that writers who have contributed pointed articles on the problem include the following: Barr (1296), Crawford (1300, 1301), Good (1302, 1303), Sears (1307), Stephan (1309, 1310), Symonds (1311), and Walker (1314). Boyd (1297) wrote at some length from the background of physical science research.

Organized Research in Other Fields

Research in education is part of a broad attack upon problems along all fronts of knowledge which is characteristic of our times. We should view educational research not as a solitary enterprise but as one coordinate field of activity in man's general effort to satisfy his curiosity and to improve his condition. We are accordingly interested in research in other fields as a background and as a basis for comparison in our thinking. The social sciences, government, and industry will be referred to here.

Social sciences—Although the limits of the social sciences will be variously set by different workers we may say that this field has been covered generally by three books already cited: Ogg (1259) in 1928, Gee (1252) in 1934, and Spahr and Swenson (1329). To enter into further detail concerning such areas as psychology and sociology would carry us too far afield.

Research in government—The National Resources Committee (1326) has dealt at length with the amount and character of research which the federal government is carrying on. It lists thirteen fields of research, several of which are closely related to public education (p. 9). It reports that nearly 30,000 government employees are in professional and scientific work (not necessarily research) and that in 1936-37 the government spent about \$65,000,000 from regular funds and about \$20,000,000 from emergency funds for research of various kinds (p. 8). Another estimate yields a higher figure. According to official reports the government spends over \$30,000,000 per year on agricultural research and experimentation alone (1318, 1322). Spahr and Swenson (1329) discuss international, federal, state, and municipal research.

Research in industry—The National Resources Committee expects to report later on research by industrial laboratories and by business organizations. It comments at present: "Industrial and commercial concerns have become so keenly aware of the importance of scientific research in anticipating and meeting competition that many of them maintain staffs of

trained scientists and invest liberally in the support of investigations made by these scientists" (1326:5). The Committee quotes Hamor (1321), assistant director of the Mellon Institute of Industrial Research, in estimating that in 1937 25,000 persons were employed in industrial research and that \$100,000,000 was spent for this purpose. Other statements on the amount spent run to twice this figure (1217, 1318, 1322). There is a handbook describing industrial research laboratories (1325) and a list of scientific and technical societies (1324). For further literature one may consult the topic "Industrial Research" in the *Industrial Arts Index*.

Articles dealing with various phases of education and industrial research have been written by Ayres (1319), Baird (1320), Mavis (1323), Potter (1327), Scates (1328), and Woods (1330). Spahr and Swenson (1329) also dealt with industrial research, and Boyd (1297) gave a general description of the nature (and romance) of research in industry.

Research areas that have not been included—There are a number of organizations carrying on educational research that have not been treated here. These include private schools, various state and regional education associations having somewhat special purposes, and special state, city, and voluntary organizations or institutes such as those for psychological patients, for physical rehabilitation, for vocational readjustment, and for juvenile delinquency and guidance. As related particularly to industry, the research on business and commercial activities and problems was omitted, although there are numerous bureaus in universities.

Concluding Statement

Research bureaus in education are a product of the past thirty years. They have done much to advance research; but there is need for further clarification of their role in field practice. The diversity of hopes and expectations which have characterized their establishment indicates the need for a wide variety of technical services in educational systems. It will be well if administrators, while providing for these technical services, will recognize that a certain proportion of time should be set aside for making studies of the less routine sort which have more far-reaching significance and more permanent value. It will be well also if research is looked upon in each individual school system or state not as a narrow activity confined to a single area of education, but as one phase of each area, and provision made accordingly. Research is larger than statistical work; it is something more than testing. It is a continuous fact-finding, exploring, investigating service applicable to all aspects of education—administration, business management, finance, schoolbuilding, transportation, curriculum, testing, instruction, and psychological and sociological principles. The fact that research is often identified with only one phase of education means that educators are failing to take advantage of the benefits which current educational research stands ready to afford.

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Chapter XII. Rating Scales, Score-Cards, and Checklists

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¹ Corrected up to December 1, 1939. Errors should be reported to the Secretary-Treasurer immediately.

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Index to Vol. IX, No. 5, December 1939

References in this Index are to the beginning of chapters and their subdivisions, and to the first allusion in running (perhaps intermittent) discussions. One should scan several pages following the one cited.

- Activity programs, equipment, 527
Administration, history of, 459
American Council on Education, 570
Analysis of variance, 545, 561
Appraisal, of courses of study, 525; of institutions, 523; of instruction, 525; of instructional material, 526; of school buildings, 527; *see also* evaluation; measurement; rating; textbook appraisal
Aptitude, for college, 517; for high school, 517; measurement, 517
Assumptions, 559; in research, 468
Attitudes, 471; social, 520

Behavior patterns, 473
Bibliographical work, aids, 453, 457; *see also* historical method; legal research; microphotography
Biographies, 457, 484
Bureaus of research, *see* organized research
Business, status and trends, 540

Case study, 483; in instruction, 486
Causation, 556
Checklists, for behavior, 474; for courses of study, 525; for institutions, 524; for instruction, 525; for parent-child relationships, 487; for special education, 525; *see also* rating
City school systems, bureaus of research, 581
Classification of cases, 467, 473
Clinical approach, 483
Colleges and universities, accrediting, 512, 536; bureaus of research, 584; faculty research, 585; *see also* higher education
Cooperative research, 571, 587
Cooperative Study of Secondary School Standards, 572
Correlation, technic, 547
Cost, trends, 534; of living, 535, 538
Criticisms, of research, 502
Curriculum making, frequency studies, 466

Definitions, in research, 474, 556
Delinquency, development of delinquent careers, 488; treatment programs, 485

Depression, effects on education, 573
Documentary analyses, quantitative, 466

Educational Policies Commission, 573
Electro-galvanometric studies, 492, 495, 565
English, errors, 470
Environment, 493
Errors, 470; of measurement, 548; *see also* English, errors
Evaluation, of educational outcomes, 521
Evaluation Staff, 521
Experimentation, classroom, 555; laboratory, 564; technic, 551, 555, 564
Eye movement studies, 564

Factor analysis, 515, 528; history, 528
Factor clusters, 488
Federal government, research by, *see* research, in government; U. S. Office of Education
Federal support of education, 534
Field research, 580, 587
Follow-up studies, 485
Foundations, philanthropic, 569
Frequency studies, *see* documentary analyses

Genetic research, 491
Graduate education, rating, 537
Growth and development, technics of study, 491; curves, 493

Heredity, 493
Higher education, buildings, 512; surveys, 511; *see also* colleges and universities; graduate education
Historical method, 456; *see also* bibliographical work; documentary analyses
History of education, 457
Hollerith, *see* tabulating machines
Home, 492
Homogeneity of data, 582
Hypotheses, 551

Index numbers, 522
Industry, *see* research, in industry
Infants, growth, 492
Intelligence, and environment, 493, 515; changes in, 515

- Intelligence tests, 514; bibliographies, 516; individual, 514
 Interpretation, 466
 Interviews, 484, 498; in research, 500; in teaching, 501; reliability and validity, 498
 Laboratory studies, 564
 Laterality, 567
 Legal research, methods, 460; *see also* bibliographical work
 Legislation and court decisions, 459, 461; needed research, 463
 Library procedures, *see* bibliographical work
 Measurement, 514, 574; bibliography, 520; criticisms of, 523; philosophy of, 520; *see also* norms; reliability; scaling; tests and scales; validity
 Mechanical aptitudes, 518
 Microphotography, 455
 Motion pictures, frequency analysis, 467
 Motor abilities, 493
 National Education Association, Research Division, 578
 Needed research, legal aspects, 461
 Negro education, support of, 570
 Norms, 512; factors affecting, 492; use of, 495
 North Central Association of Colleges and Secondary Schools, 512
 Note taking, *see* bibliographical work
 Objectives, broadened, 522
 Objectivity, of direct observation, 474
 Observation, as a research technic, 472; reliability, 478; *see also* recording of observations
 Organized research, 569, 576
 Parent-child relationships, 487
 Personality, development of, 494; measurement, 518
 Photographic recording, 474, 566; roentgenographs, 494; *see also* eye movement studies; microphotography
 Physical education, measurement, 513; surveys, 513
 Physical development, curves, 493; prediction, 493
 Prenatal development, 492, 494
 Professional aptitudes, 518
 Profiles, 536
 Public relations, and research, 583
 Questionnaires, 509; studies of, 502
 Rating, 520; of pupils, 526; of teachers, 526; scales, 526; *see also* appraisal; checklists; score-cards
 Reading, and visual ability, 567; diagnosis, 565; difficulty of material, 471
 Reasoning, studies of, 492
 Recording of observations, 474; *see also* photographic recording; sound recording; stenographic recording
 Records, pupil personnel, 484
 Reliability, calculation of, 549; concept of, 521, 552; of direct observation, 477; of interviews, 498; of laboratory instruments, 565, 568; of questionnaire data, 502
 Research, in government, 589; in industry, 589; *see also* assumptions; bibliographical work; case study; cooperative research; documentary analyses; experimentation; field research; genetic research; historical method; interviews; laboratory studies; legal research; methods; microphotography; observation; organized research; questionnaires; rating; statistical methods; surveys; tabulating machines; theses
 Sampling, 468, 478, 541, 553, 559
 Scaling, 554; case histories, 487, 521
 School buildings, appraisal, 512, 527
 Score-cards, 512, 527; *see also* rating
 Scoring, of direct observations, 476
 Social background of education, 458
 Social patterns, 486
 Social pressure on schools, 458
 Social Sciences, research in, 589
 Social surveys, 508; methods, 509
 Sound recording, 474, 499, 564
 State education associations, research, 580
 State school systems, bureaus and departments of research, 579, 587; evaluation, 524, 535
 Statistical methods, 543; *see also* analysis of variance; correlation; factor analysis; index numbers; research; sampling; scaling; tests of significance; weighting

- Stenographic recording, 474
Superstitions, 503
Surveys, 508; bibliography, 511; city, 512; higher education, 511; history, 511; methods, 511; *see also* social surveys
Tabulating, 469
Tabulating machines, 470, 554
Teacher education, 572
Teaching load, 537
Tests and scales, 514, 520; construction of, 522; *see also* measurement
Tests of significance, 551, 559
Textbook appraisal, 526
Theses, 586
Time studies, 476
Training of research workers, 588
United States Office of Education, 511, 576, 587
Unit, observation, 474
Validity, of interviews, 499; of questionnaire data, 504; technic of validation, 554; technics for validating, 487; technics, 521
Visual defects, and reading, 568
Vocabulary, frequency studies, 468
Vocational aptitudes, 518
Vocational interests, 519
Weighting, 538, 541, 549

Index to Volume IX

- Ability grouping, 178, 360; *see also* exceptional children
- Absence, *see* attendance
- Accounting, child; *see* records, reports, school census, and cross references under school population
- Achievement, and intelligence, 156; and promotion, 170; prediction of, 156, 200; survey of, 156; *see also* study, methods; success in school
- Activity curriculum, history, 340
- Activity programs, 302; equipment, 527
- Administration, history of, 459
- Adapting instruction to pupils, 177
- Adjustment, 150; diagnosis, 215; interviews, 212; mechanisms, 288; scales, 198; *see also* personality; environment
- Adolescence, 290; mental development, 38; pubescence, 72
- Adult education, Americanization, 354; guidance, 192; history, 352; *see also* forums; illiteracy
- African education, 398; finance, 406
- Age-grade status, *see* progress in school
- Age-height-weight, *see* nutrition; physical development
- Agricultural education, 408; bibliography, 409; *see also* vocational education
- American Council on Education, 570
- Americanization, *see* adult education
- Analysis of variance, 545, 561
- Anecdotal records, 174
- Anthropometry, 80
- Antisocial behavior, 183; *see also* behavior
- Appraisal, of courses of study, 525; of education in China, 386; of guidance programs, 196-220; of institutions, 523, 524; of instruction, 525; of instructional material, 526; of marking systems, 172; of school buildings, 527; of teaching, *see* rating of teachers; *see also* evaluation, measurement, rating, textbook appraisal
- Aptitude, for college, 517; for high school, 517; measurement, 517; *see also* vocational aptitude
- Arithmetic, development of concepts, 32, 289
- Art, ability, 34; *see also* esthetic development
- Assumptions, 559; in research, 468
- Attendance, absence, 162; amount, 164; legal aspects, 167; services, 161; *see also* pupil personnel services, school census
- Attitudes, 471; social, 520; survey of, 150, 153, 157
- Atypical children, *see* exceptional children
- Auditory aids, 301
- Autobiographies, *see* records
- Behavior, antisocial, 183; patterns, 473; problems, 151; rating, 200; *see also* adjustment; personality
- Bibliographical work, aids, 453, 457; *see also* historical method; legal research; microphotography
- Bibliographies, adult education, 417; case method, 599; characteristics of pupil population, 221; classroom experimentation, 629; comparative colonial education, 440; comparative school finance, 441; comparative vocational education and guidance, 443; concepts of education in Czechoslovakia, 432; current historiography, 593; development of motor functions and mental abilities in infancy, 111; direct observation as a research method, 597; education and social trends, 419; education in the ancient world, 436; educational changes in Germany, 1936-1939, 428; educational research in Latin America, 427; elementary education, 413; factor analysis, 619; general methods of teaching, 327; genetic method, 602; higher education, 415; history of education in the British Commonwealth of Nations, 421; history of education in the Far East, 433; index numbers and related composites, 622; the interview, 607; laboratory investigations, 630; legal research in education, 594; library and bibliographical procedure, 591; mental and motor development from two to twelve years, 114; mental development in adolescence, 125; motivation, emotional responses, maturation, intelligence, and individual differences, 321; organized research in education: foundations, commissions, and committees, 633; organized research in education: national, state, city, and university bureaus of research, 635; physical growth from birth to maturity, 125; physiological factors and mental development, 136; preschool education, 412; programs of guidance and counseling, 236; quantitative analysis of documentary materi-

- als, 595; questionnaires, 608; rating scales, score-cards, and checklists, 617; relationships in physical and mental development, 134; school and community surveys, 609; school organization and classroom adjustment, 227; secondary education, 413; statistical methods, 626; supervision, 328; technics of guidance and counseling, 240; technics of research in physical growth and anthropometry, 133; testing: intelligence, aptitude, personality, achievement, 610; theoretical aspects of learning and transfer of training, 312; types of learning and general conditions affecting learning, 318
- Bibliography, criticisms of, 523
- Bilingual pupils, and intelligence, 25
- Bilingualism, and intelligence, 293
- Biographies, 348, 457, 484
- Birth-rates, 26
- Blind, 182
- Bureaus of research, *see* organized research
- Business, status and trends, 540
- Canadian education, finance, 404; history, 365
- Case study, 206, 209, 483; clinical counseling, 214; in instruction, 486; needed research, 212
- Causation, 556
- Census, *see* school census
- Central American education, *see* Latin American education
- Checklists, for behavior, 474; for courses of study, 525; for institutions, 524; for instruction, 525; for parent-child relationships, 487; for special education, 525; for supervision, 305; *see also* rating
- Child accounting, *see* records; reports; school census; and cross references under school population
- Child study, *see* infants
- Chinese education, finance, 404; history, 384
- Cinema, *see* photographic recording
- City school systems, bureaus of research, 581
- Classical education, 391
- Classification of cases, 467, 473
- Clinical approach, 483
- College, admission, 200; orientation, 217; *see also* particular topic; achievement; higher education; prediction
- Colleges and universities, accrediting, 512, 536; bureaus of research, 584; faculty research, 585; *see also* higher education
- Colonial education, 395
- Comparative education, 361; bibliographies, 401; *see also* foreign education
- Compulsory attendance, *see* attendance
- Conduct, *see* behavior
- Contemporary problems, 360
- Cooperative research, 571, 587
- Cooperative Study of Secondary School Standards, 572
- Correlation, technic, 547
- Cost of living, 535, 538; trends, 534
- Counseling, *see* guidance
- Court decisions, on attendance, 167
- Crippled children, 182
- Criticisms, of research, 368, 502
- Culture variations, problems, 370
- Cumulative records, *see* records
- Curriculum making, frequency studies, 466
- Curves, for mental development, 92; for physical development, 49, 52, 79, 89, 92; of learning, 282; of mental growth, 39
- Czechoslovakian education, 377, 405
- Deaf and hard-of-hearing, 182
- Definitions, in research, 474, 556
- Delinquency, development of delinquent careers, 488; treatment programs, 485; *see also* behavior, antisocial
- Depression, effects on education, 402, 573
- Development, *see* growth
- Diagnosis, personality and adjustment, 215
- Diary, *see* records
- Diet, and growth, 59; *see also* nutrition
- Differences, *see* variability
- Documentary analyses, quantitative, 466
- Drawing, development, 289
- Dutch education, colonial policies, 399
- Educational guidance, *see* guidance
- Educational philosophy, 342, 378
- Educational Policies Commission, 573
- Educational sociology, 379
- Electro-galvanometric studies, 492, 495, 565

- Elementary education, history, 340
- Elementary school, *see* particular topic
- Emotion, 286; *see also* fear
- Endocrine glands, 71; *see also* mental development; physical development
- England, *see* Great Britain
- English, errors, 470
- Environment, 493; and delinquency, 29; and intelligence, 11, 21, 29, 41, 98, 292; and social behavior, 370; socioeconomic factors, 213; *see also* adjustment, family relations
- Errors, 470; of measurement, 548; *see also* English, errors
- Esthetic development, 34; *see also* art; music; poetry; rhythm
- Eugenics, *see* birth-rates
- European education, *see* foreign education
- Evaluation of educational outcomes, 521; of guidance, 185; *see also* appraisal; rating; tests and scales
- Evaluation Staff, 521
- Exceptional children, 181, 293; *see also* handicapped children; retarded children; special education; superior children; unstable children
- Experimentation classroom, 555; laboratory, 564; technic, 551, 555, 564
- Extensions of education, 359; *see also* adult education; higher education, extension; preschool education
- Eye movement studies, 564
- Factor analysis, 19, 25, 36, 79, 290, 515, 528; history, 528
- Factor clusters, 488
- Failure, *see* achievement; progress in school; promotion of pupils; pupil personnel services; success in school
- Family relations, 289
- Fear, 287
- Federal government, research by, *see* research, in government; U. S. Office of Education
- Federal support of education, 534
- Field research, 580, 587
- Finance, *see* depression, support of education
- Follow-up studies, 409, 485
- Foreign education, for more specific references, *see* level, subject, or country
- Foreign language, 283
- Foreign-speaking persons, 354
- Forums, 353
- Foundations, philanthropic, 569
- French education, colonial policies, 397; finance, 406
- Frequency studies, *see* documentary analyses
- Genetic research, 491
- Genetic studies, *see* esthetic development; intelligence
- German education, 372; finance, 406; history, 372; vocational, 409
- Gifted children, 293
- Graduate education rating, 537
- Graphs, *see* pictures
- Great Britain, colonial policies, 395; history of education, 361, 382; support of education, 402, 405; vocational education, 409; *see also* African education; Canadian education; India
- Growth, curves of, 39, 49, 52, 79, 89; nature of, 78; of infants, 5; of intelligence, 18; of schools, 163; physical, 47; technics of study, 80; *see also* intelligence; physical development
- Growth and development, curves, 493; technics of study, 491; *see also* adolescence; arithmetic, development of concepts; drawing, development; environment; language development; mental development; physical development; records; social maturity
- Guidance and counseling, 185, 196, 214, 410; appraisal, 196-220, 410; group, 217; in college, 187; in other countries, 410; needed research, 187; *see also* interview; vocational aptitude
- Handedness, *see* laterality
- Handicapped children, *see* behavior, anti-social; blind; crippled children; deaf and hard-of-hearing; exceptional children; mentally retarded children; remedial instruction; special education; speech defects
- Health, and physical development, 62; *see also* physical development
- Heart, 69
- Height, *see* physical development
- Heredity, 493
- High school, *see* particular topic
- Higher education, 347; bibliography, 347; buildings, 512; characteristics of students, 155; extension, 352; finance, 351; history, 347; in other countries,

- 403; legal aspects, 351; surveys, 511; *see also* colleges and universities, graduate education
- Historical method, 456; *see also* bibliographical work; documentary analyses
- History of education, 337, 457; for more specific references, *see* level, subject, or country
- Hollerith, *see* tabulating, machines
- Home, 492
- Homogeneity of data, 582
- Hypotheses, 551
- Illiteracy, 354; *see also* adult education
- Incentives, and learning, 30; and test scores, 26
- Index numbers, 532
- India, history of education, 381; support of education, 406
- Indians, education of, 370
- Individual differences, *see* variability between individuals
- Industry, *see* research, in industry
- Infants, growth, 5; physical measurements, 52, 83; physical norms, 47; study of, 6
- Infants growth, 492
- Insight, *see* learning
- Instruction, *see* activity programs; auditory aids; learning; methods; supervision; teaching success; visual aids
- Intelligence, and birth rank, 100; and environment, 11, 21, 41, 98, 291, 493, 515; and health, 96; and heredity, 292; and motor abilities, 96; and physical characteristics, 94; and premature birth, 97; and race, 27; and schooling, 42; and season of birth, 98; and transfer of training, 271; changes in, 515; constancy, 19, 22, 40, 291; development, 148; factors, 290; growth, 18; of high-school pupils, 42; of infants, 6; of training, 271; personal constant, 21; sex differences, 42; surveys, 152, 291; *see also* environment; mental defectives; mental development; mentally retarded children; racial differences; retarded children; superior children
- Intelligence tests, 271, 514; bibliographies, 516; for infants, 6; individual, 514
- Interests, *see* attitudes
- Interpretation, 466; of data, 215
- Interviews, 201, 484, 498; in research, 500; in teaching, 501; needed research, 204; reliability and validity, 498; *see also* guidance and counseling
- Japanese education, history, 388
- Junior college, statistics, 346
- Junior high school, history, 344
- Kindergarten, history, 338
- Laboratory studies, 464
- Language, development of, 16, 33, 289; *see also* foreign language
- Laterality, 15, 567
- Latin American education, 368; history, 369; needed research, 368
- Leadership, 153
- Learning, 297; curves, 282; insight, 263; laws, 257; needed research, 294; organization, 262; practice, 276; psychology, 255, 274, 285; studies of, 30; whole-part, 277; *see also* problem solving; study methods
- Legal research methods, 460; *see also* bibliographical work
- Legislation, attendance, 167
- Legislation and court decision, 459, 461; needed research, 463
- Library, 309
- Library procedures, *see* bibliographical work
- Marks, 172; *see also* records; reports on pupils
- Measurement, 514, 574; and incentives, 26; bibliography, 520; philosophy of, 520; physical, 80; *see also* normal reliability; scaling; tests and scales; validity
- Mechanical aptitudes, 518
- Memory, 44, 279; studies of, 30
- Mental defectives, 101
- Mental development, 288; adolescence, 38; and glands, 104; and nutrition, 103; and physical development, 91, 103; and pubescence, 108; curves, 39, 92; factors affecting, 41; of infants, 5; *see also* intelligence
- Mental hygiene, 212
- Mentally retarded children, 183
- Methods of teaching, 295, 360; *see also* study methods
- Mexican education, *see* Latin American education
- Microphotography, 455

- Mission education, 384, 387, 389, 395, 398
 Motion pictures, frequency analysis, 467;
see also photographic recording
 Motivation, 285
 Motor abilities, 8, 13, 35, 493; and intelligence, 96; *see also* physical development
 Music, ability, 34
- National Education Association, Research Division, 578
 Nationality, *see* bilingual pupils
 Nature and nurture, 11, 26; *see also* environment; intelligence
 Needed research, case study, 212; guidance, 187; handicapped children, 182; history of higher education, 348; in Latin America, 368; interviews, 204; learning, 294; legal aspects, 461; mental development, 45; personality and adjustment, 160; rating, 201; social background of education, 357
 Negro education, support of, 570
 Norms, 169, 512; factors affecting, 492; for physical development, 48; use of, 495
 North Central Association of Colleges and Secondary Schools, 512
 Note taking, *see* bibliographical work
 Nursery schools, 23; history, 338
 Nutrition, 103; *see also* diet; health; physical development
- Objectives, broadened, 522
 Objectivity, of direct observation, 474
 Observation, as a research technic, 472; reliability, 478; *see also* recording of observations
 Occupations, *see* guidance
 Organization of schools, functional, 161; *see also* pupil personnel services
 Organized research, 569, 576
 Orientation, *see* college
 Out-of-school youth, *see* youth
- Parent-child relationships, 487
 Persistence in school, 172; *see also* cross references under school population
 Personality, 150, 154, 158; development of, 494; measurement, 518; scales, 198; *see also* adjustment; behavior; rating
 Personnel work, *see* pupil personnel services
 Philosophy, *see* educational philosophy
- Photographic recording, 80, 474, 566; of infants, 9; of physical development, 82; roentgenographs, 80, 494; *see also* eye movement studies; microphotography
 Physical development, 47, 80, 147, 151, 155, 288; age, height, weight, 74; and birth rank, 54; and glands, 105; and health, 62; and mental development, 91; and premature birth, 54; and season, 56; curves, 49, 92, 493; norms, 48, 74; of infants, 5, 13; prediction, 493; *see also* growth; motor abilities; nutrition
 Physical education, history, 392; measurement, 513; surveys, 513
 Physically handicapped, *see* handicapped children
 Pictures, appreciation of, 34; *see also* photographic recording
 Poetry, 22, 35
 Prediction, of future education, 344; *see also* achievement
 Prenatal development, 492, 494
 Preschool education, history, 337
 Problem solving, 274; *see also* learning
 Professional aptitudes, 518
 Profiles, 536
 Progress in school, 168; *see also* promotion of pupils; success in school
 Promotion of pupils, 168; failure, 171
 Prophecies, *see* prediction
 Public relations, and research, 583
 Pupil personnel services, 147; organization, 166; *see also* adapting instruction to pupils; adjustment; attendance; counseling; guidance; records; school census; school population; variability between individuals
 Puberty, *see* adolescence
- Questionnaires, 509; studies of, 502
- Racial differences, 27, 293; in mental ability, 10; physical, 56
 Rating, 520; needed research, 201; of pupils, 526; of teachers, 199, 526; scales, 199, 526; *see also* adjustment; appraisal; behavior; checklists; personality; score-cards
 Reading, and visual ability, 567; diagnosis, 565; difficulty of material, 471; in college, 180
 Reasoning, studies of, 31, 492

- Recording of observations, 474; *see also* photographic recording, sound recording, stenographic recording
- Records, autobiographies, 206; biographies, 289; pupil personnel, 174, 204, 212; *see also* anecdotal records; marks; reports on pupils; stenographic records
- Reliability, calculation of, 549; concept of, 521, 552; of direct observation, 477; of interviews, 202, 498; of laboratory instruments, 565, 568; of physical measurement, 85; of questionnaire data, 502
- Remedial instruction, 180
- Reports, on pupils, 172
- Research, in government, 589; in industry, 589; in Latin America, 368; in other countries, 403; technics in physical development, 80; technics of infant study, 6; trends in psychology, 266; *see also* appraisal; assumptions, bibliographical work; case study; co-operative research; documentary analyses; experimentation; field research; genetic research; historical method; interpretation of data; interviews; laboratory studies; legal research; methods; microphotography; needed research; observation; organized research; questionnaires; rating; records; statistical methods; surveys; tabulating, machines; tests and scales; theses; particular subject field or topic
- Retardation, *see* mentally retarded children; progress in school
- Retarded children, 28
- Rhythm, 36
- Roentgenographs, *see* photographic recording
- Rural education, in Latin America, 369; supervision, 309
- Sampling, 468, 478, 541, 553, 559
- Scaling, 554; case histories, 487, 521
- School buildings, appraisal, 512, 527
- School census, 165; *see also* cross references under school population
- School population, characteristics, 147; number and change, 344, 359; *see also* achievement; attendance; exceptional children; growth of schools; persistence in school; pupil personnel services; progress in school; school census; surveys; variability between individuals
- Score-cards, 512, 527; *see also* rating
- Scoring, of direct observations, 476
- Secondary education, history, 342
- Sex differences, 42, 293; in intelligence, 27, 42; *see also* physical development
- Size of classes, 179
- Social background of education, 342, 357, 458; needed research, 357; *see also* contemporary problems
- Social conditions and changes, 357
- Social maturity, 29, 292
- Social patterns, 486
- Social pressure on schools, 458
- Social sciences, research in, 589
- Social surveys, 508; methods, 509
- Socio-economic factors, *see* environment
- Socio-economic status, *see* environment
- Sound recording, 311, 474, 499, 564
- South American education, *see* Latin American education
- Special education, 180; *see also* exceptional children
- Speech defects, 183
- State education associations, research, 580
- State school systems, bureaus and departments of research, 579, 587; evaluation, 524, 535; history, 340
- Statistical methods, 543; *see also* research; analysis of variance, correlation, factor analysis; index numbers; sampling; scaling; tests of significance; weighting
- Stenographic recording, 310, 474
- Students, *see* college; higher education; school population
- Study methods, 150, 219, 296, 299
- Success in school, factors, 156; *see also* achievement; progress in school; remedial instruction
- Superior children, 28
- Superstitions, 22, 503
- Supervised study, *see* methods, of teaching; study methods
- Supervision, 303; appraisal, 309; criteria, 305
- Support of education, in other countries, 401
- Surveys, 508; achievement, 156; bibliography, 511; city, 512; guidance, 185; higher education, 511; history, 511; methods, 511; vocational, 409; youth, 192; *see also* adjustment; attitudes; school populations; social surveys
- Tabulating, 469; machines, 470, 554
- Taxation, in other countries, 403
- Teacher rating, *see* rating

- Teacher training, 304, 572; in-service, 306
- Teaching load, 537
- Teaching success, criteria, 296, 304
- Teeth, 60, 64, 88
- Tests and scales, 199, 514, 520; construction of, 522; for infants, 6; *see also* appraisal; measurement; norms; reliability; vocational aptitude
- Tests, effects on study, 266; of significance, 551, 559
- Textbook appraisal, 526
- Theses, 586
- Time studies, 476
- Training of research workers, 588
- Transfer of training, 268
- Trial-and-error, *see* learning
- Unit, 474
- United States Office of Education, 511, 576, 587
- Unstable children, 29
- Validity, of interviews, 499; of questionnaire data, 504; technics, 521; technics for validating, 487, 554
- Variability between individuals, 147, 156, 292; *see also* exceptional children; school population
- Visual aids, 284, 301
- Visual defects, and reading, 568
- Vocabulary, 26, 29, 33, 45; frequency studies, 468
- Vocational aptitude, 518; tests, 197
- Vocational education, in other countries, 408; research, 408; *see also* agricultural education
- Vocational guidance, *see* guidance
- Vocational interests, 155, 159, 519
- Weight, *see* physical development
- Weighting, 538, 541, 549
- Whole-part learning, *see* learning
- Writing, history of, 392
- Youth, 154; surveys, 192; *see also* adolescence

R

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Vol. I
TEACHERS
Vol. I
SCHOOL ORGANIZATION
Vol. I
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Vol. I
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